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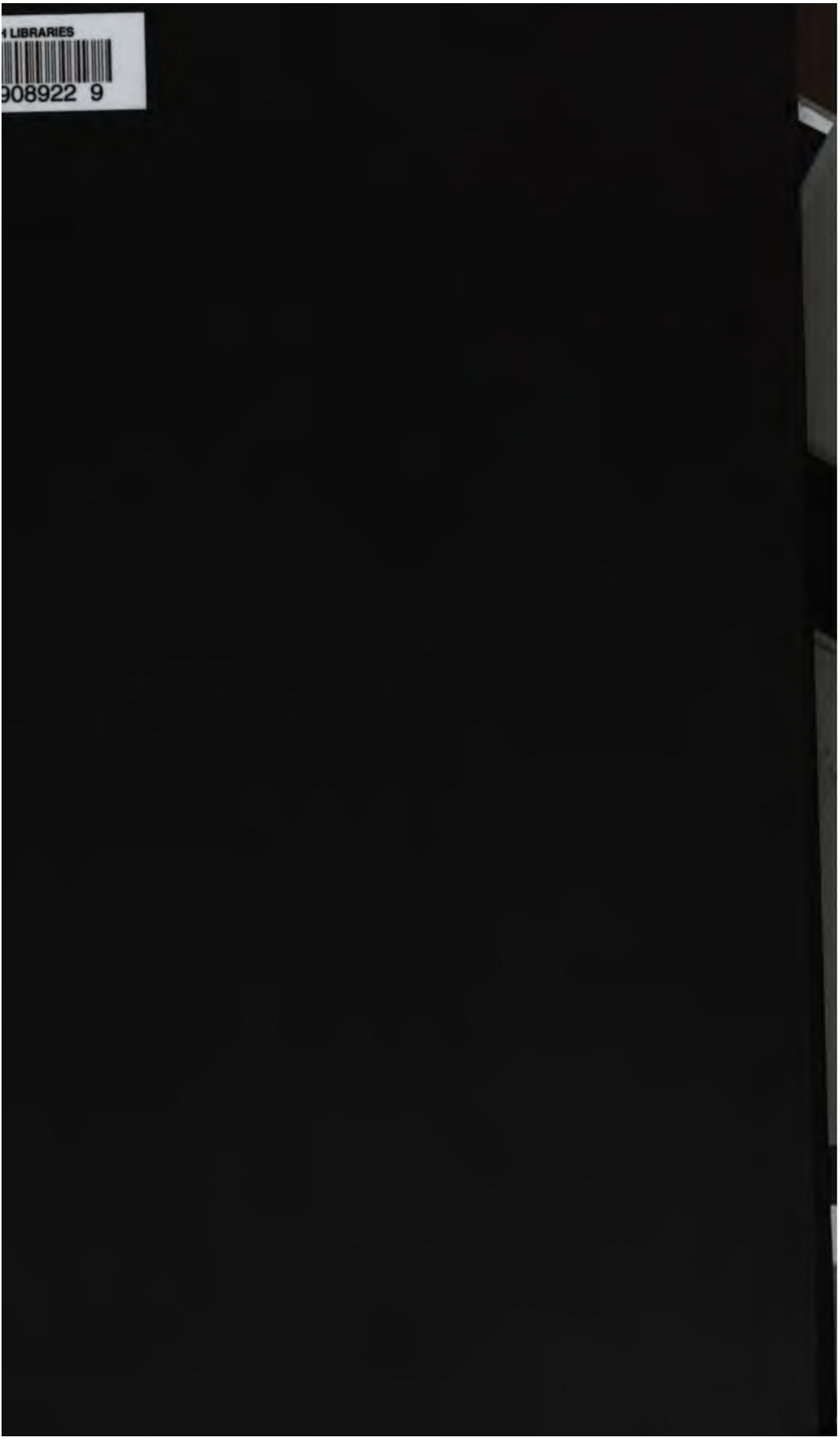
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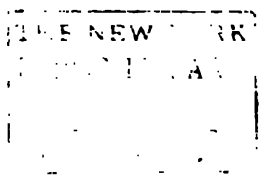

C. W. Fish

TRANSACTIONS

OF THE

New England

COTTON MANUFACTURERS' ASSOCIATION.

Founded April 20, 1865. Incorporated Dec. 1, 1894.

NO. 71.

SEMI-ANNUAL MEETING.

Held at International Hotel, Niagara Falls, N. Y.,

SEPTEMBER 25-26, 1901.

Office of the Association:

Room 57, International Trust Building, 45 Milk Street,
Corner of Devonshire St., Boston, Mass.

WALTHAM, MASS.:
PRESS OF E. L. BARRY,
1901.

23597

Entered according to Act of Congress
in the Year 1896
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in the Office of The Librarian of Congress
at Washington.

By vote of the Board of Government, the price of the *Transactions* is $5.00 per copy to non members. The price of this issue and the one previous is $1.00 each to members, and the prices of copies previous to Volume 61, is 50 cents to members, but each member is entitled to a copy as a part of the privilege of membership.

CHARTER.

No. 6091.

Commonwealth of Massachusetts.

BE IT KNOWN, That whereas, EDWARD W. THOMAS, C. J. H. WOODBURY, WILLIAM J. KENT, F. M. MESSENGER, HARRY T. WHITIN, ARTHUR H. LOWE, ALBERT F. KNIGHT, ALFRED M. GOODALE, FRED C. MCDUFFIE and GEORGE W. BEAN have associated themselves with the intention of forming a corporation under the name of the NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION, for the purpose of encouraging scientific investigation and experiment as to the methods of manufacturing cotton; collecting and imparting information relating to this industry, promoting social intercourse among its members; and establishing and maintaining a library of works on textiles in the city of Boston, and have complied with the provisions of the Statutes of this Commonwealth in such case made and provided, as appears from the certificate of the President, Treasurer and Directors of said corporation, duly approved by the Commissioner of Corporations, and recorded in this office.

Now, Therefore, I, WILLIAM M. OLIN, Secretary of the Commonwealth of Massachusetts, do hereby certify that said EDWARD W. THOMAS, C. J. H. WOODBURY, WILLIAM J. KENT, F. M. MESSENGER, HARRY T. WHITIN, ARTHUR H. LOWE, ALBERT F. KNIGHT, ALFRED M. GOODALE, FRED C. MCDUFFIE and GEORGE W. BEAN, their associates and successors, are legally organized and established as and are hereby made an existing corporation under the name of the

NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION,

with the powers, rights and privileges, and subject to the limitations, duties and restrictions which by law appertain thereto.

Seal of the Commonwealth of Massachusetts.

Witness my official signature hereunto subscribed, and the seal of the Commonwealth of Massachusetts hereunto affixed this first day of December, in the year of our Lord one thousand eight hundred and ninety-four.

WILLIAM M. OLIN,

Secretary of the Commonwealth.

Commonwealth of Massachusetts.

(Acts of 1895, Chap. 163.)

AN ACT TO AUTHORIZE THE NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION TO HOLD ITS MEETINGS WITHOUT THE COMMONWEALTH.

Be it enacted, etc., as follows:

SECTION 1. The New England Cotton Manufacturers' Association is hereby authorized to hold its meetings in any state or territory of the United States and in the District of Columbia; provided, however, that its annual meeting shall be held in this Commonwealth at least once in five years.

SECT. 2. This act shall take effect upon its passage. [Approved March 23, 1895.]

NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION.

FOUNDED APRIL 20, 1865.

INCORPORATED DECEMBER 1, 1894.

CONSTITUTION AND BY-LAWS.

ACTIVE MEMBERS.

ARTICLE 1. Any person who is actively engaged as President, Treasurer, Agent, Superintendent or Manager in the manufacture, printing or finishing of cottons shall be eligible for active membership.

ELECTION OF MEMBERS.

ARTICLE 2. All nominations for membership shall be made in writing, at least one week before the date of any regular meeting, and shall be considered by the Board of Government, and reported to the meeting, favorably or adversely, for the action of the Association. *Provided*, that in case the Board shall decide to report adversely upon any nomination, the member who shall have made it shall be informed of the intention so to report, in order that he may have an opportunity to withdraw the name. Upon such report active members may be admitted, if they obtain a majority of votes of the members present and voting therefor, by acceptance in writing, and paying an admission fee of ten dollars, and maintaining their membership by the payment of an annual assessment not exceeding ten dollars.* Any member failing to pay two successive assessments shall cease to be a member at the end of six months from the date when such second assessment shall become due. Any member may withdraw from the Association upon payment of all arrearages, first giving notice of his intention so to do, in writing, to the Secretary, and the Board of Government may accept such resignation; and any member may be expelled for cause,

* This assessment has never exceeded five dollars for active members and ten dollars for associate members.

at any regular meeting, two-thirds of the members present voting therefor.

ASSOCIATE MEMBERS.

ARTICLE 3. Persons engaged in the manufacture of cotton or cotton fabrics, or the manufacture of textile machinery, or industries kindred to the cotton manufacture, may become associate members of the Association. The methods of application, nomination, election and withdrawal from the Association being under the same conditions as those provided for active members in Article 2, excepting that this class of membership does not carry with it the privilege of voting or speaking, except by permission from the Board of Government or a vote of the Association to allow permission.

The initiation fee for associate members shall be twenty-five dollars, and the annual assessment shall be double the sum annually voted for active members.

Associate members may be expelled by a majority vote of the Board of Government.

HONORARY MEMBERS.

ARTICLE 4. Honorary members may be elected, when recommended by the Board of Government, at any regular meeting of the Association, who shall be enrolled as such, and shall be entitled to attend the meetings of the Association and participate in its proceedings, without the right to vote. They shall not be subject to payment of admission fees or assessments. No person actively engaged in cotton manufacture shall be eligible to honorary membership.

ARTICLE 5. It shall be the duty of all members of the Association to make returns to the Secretary of such statistics as may be called for by him, under the direction of any committee duly appointed for the collection of statistics, when not incompatible with private interests.

OFFICERS.

ARTICLE 6. The officers of this Association shall be a President, two Vice-Presidents, six Directors, a Treasurer, Secretary, and Auditor of Accounts.

ELECTION OF OFFICERS.

ARTICLE 7. At each annual meeting there shall be chosen by ballot a President, two Vice-Presidents and two Directors; the President and Vice-Presidents to serve one year, and the two Directors shall be chosen for terms of three years.

DUTIES OF OFFICERS.

ARTICLE 8. The President, or in his absence the senior Vice-President present, shall preside at all meetings of the Association and of the Board of Government. All officers shall hold their respective offices until their successors shall be chosen and accept their positions.

ARTICLE 9. The President, Vice-Presidents and Directors shall constitute a Board of Government, and have under their care and direction all matters pertaining to the management of the Association; and five of their number shall constitute a quorum for the transaction of business. Meetings of the board may be called by the President, at such time and place as he may deem expedient, giving each member a written or printed notice of the same at least five days before the day of meeting. At their first meeting the board shall elect a Treasurer, Secretary, and Auditor of Accounts for the year ensuing, and fix the amount of compensation of the Secretary. All vacancies in their board occasioned by death or resignation shall be filled by the board; and the persons so elected shall hold their offices until the next annual meeting. The board may, from time to time, as they shall deem expedient, appoint committees, from among their own board or from the members at large, to collect statistical information, examine new inventions or processes in manufacturing goods, as also to prepare essays on subjects of interest to the Association.

ARTICLE 10. The Treasurer shall keep a book in which all receipts and payments of money shall be entered, collect all moneys due the Association, and disburse the same upon the written order of the Board of Government. At the annual meeting in each year he shall make an exhibit of his accounts, or oftener if the Board of Government require it. He shall notify the members of assessments voted, and cause them to be collected in a reasonable time.

ARTICLE 11. The Secretary shall attend all meetings of the Association and of the Board of Government, and keep accurate records of

their doings. In the absence of the Secretary at any meeting, a Secretary *pro tem.* may be appointed by the presiding officer, who shall be sworn to do all things, while in office, required of the Secretary.

ARTICLE 12. The Auditor shall examine the accounts of the Treasurer annually, and report at each meeting the state of the finances.

MEETINGS.

ARTICLE 13. The annual meeting of the members of the Association shall be held on the last Wednesday of April, or at such other time, and at such hour and place as the Board of Government may appoint. There shall also be a semi-annual meeting of the Association on the last Wednesday of October, in each and every year, or at such other time, and at such place and hour as the Board of Government may appoint.

Special meetings may be called by the Board of Government whenever they deem it expedient, or upon the written application of any ten members, made to the Secretary.

ARTICLE 14. All meetings of the members of the Association shall be in pursuance of a written or printed notice, addressed to each member, with the name of the President or Secretary attached thereto, and deposited in the Post Office ten days at least before the day of meeting, specifying the time and place of meeting; and at all such meetings fifteen members shall constitute a quorum for the transaction of business.

ARTICLE 15. Amendments to the By-Laws may be made at any stated meeting of the Association by a two-thirds vote; *provided*, notice of such proposed amendment be given in writing at a previous meeting, and also notice be given to each member by the Secretary, of the pendency of such amendment, ten days at least before any such meeting.

BOARD OF GOVERNMENT.

1901.

PRESIDENT.

CHARLES H. FISH, ... DOVER, N. H.

VICE-PRESIDENTS.

GEORGE H. HILLS, ... FALL RIVER, MASS.

HERBERT E. WALMSLEY, . . . NEW BEDFORD, MASS.

DIRECTORS.

ALFRED E. ADAMS, ... WHITINSVILLE, MASS.

WILLIAM D. HARTSHORNE, . . LAWRENCE, MASS.

JAMES R. MACCOLL, ... PAWTUCKET, R. I.

W. B. SMITH WHALEY, ... COLUMBIA, S. C.

A. TENNY WHITE, ... MANVILLE, R. I.

GEORGE F. WHITTEN, . . . MANCHESTER, N. H.

AUDITOR.

C. E. ROBERTS, ... BOSTON, MASS.

SECRETARY AND TREASURER.

C. J. H. WOODBURY, P. O. Box 3672, BOSTON, MASS.

OFFICE OF THE ASSOCIATION:

ROOM 57, INTERNATIONAL TRUST BUILDING, 45 MILK STREET, CORNER OF DEVONSHIRE STREET, BOSTON, MASS.

OFFICERS OF THE ASSOCIATION,

FROM THE FIRST ORGANIZATION.

PRESIDENTS.

Ezekiel A. Straw,	1865–78	Edw. W. Thomas,	1894–95
Amos D. Lockwood,	1878–80	A. M. Goodale,	1895–96
John Kilburn,	1880–83	Arthur H. Lowe,	1896–97
William C. Lovering,	1883–85	Russell W. Eaton,	1897–98
Richard Garsed,	1885–86	Stephen A. Knight,	1898–99
J. S. Ludlam,	1886–88	Frederick E. Clarke,	1899–99
Henry F. Lippitt,	1888–89	D. M. Thompson,	1900–01
Walter E. Parker,	1889–92	CHARLES H. FISH,	1901–
Robert McArthur,	1892–94		

VICE-PRESIDENTS.

Amos D. Lockwood,	1865–77	Arnold B. Sanford,	1888–91
William A. Burke,	1865–73	Robert McArthur,	1889–92
John C. Palfrey,	1873–76	Simeon B. Chase,	1891–93
Edward Atkinson,	1876–78	E. W. Thomas,	1892–94
A. G. Cumnock,	1877–80	A. M. Goodale,	1893-95
Charles Nourse,	1878–81	William J. Kent,	1894–97
William F. Goulding,	1880–83	Fred. C. McDuffie,	1895–00
Richard Garsed,	1881–85	Henry T. Whitin,	1897–00
J. S. Ludlam,	1883–86	C. H. Richardson,	1900–01
Walter E. Parker,	1885–89	GEORGE H. HILLS,	1900–
Richard B. Borden,	1886–88	H. E. WALMSLEY,	1901–

DIRECTORS.

J. S. Davis,	1865–69	A. G. Cumnock,	1869–77
Charles Nourse,	1865–78	F. E. Clarke,	1869–75
Phineas Adams,	1865–74	S. S. Spencer,	1887–90
William P. Haines,	1865–69	E. W. Thomas,	1888–92
Thomas J. Borden,	1865–78	William W. Whitin,	1888–93
Daniel D. Crombie,	1865–68	Robert R. Smith,	1889–92
Cyrus I. Barker,	1875–80	Alfred M. Goodale,	1890–93
Hervey Kent,	1877–81	William J. Kent,	1891–94
David J. Johnston,	1878–82	Herman F. Straw,	1891–93
Walter Paine, 3d,	1878–80	Fred C. McDuffie,	1892–95
Chas. L. Lovering,	1878–83	George W. Bean,	1892–95
Richard Garsed,	1880–81	F. M. Messenger,	1893–95
William H. Jennings,	1880–83	Arthur H. Lowe,	1894–96
Chas. D. McDuffie,	1881–83	Henry T. Whitin,	1894–97
Walter E. Parker,	1881–85	Herbert L. Pratt,	1895–98
John W. Danielson,	1881–85	Stephen A. Knight,	1895–98
William E. Barrows,	1882–83	Russell W. Eaton,	1896–97
Rufus A. Maxfield,	1883–86	Albert F. Knight,	1893–99
George W. Weeks,	1883–86	John Eccles,	1895–99
Henry S. Howe,	1883–87	C. H. Richardson,	1897–00
Richard B. Borden,	1883–86	George H. Hills,	1897–00
O. S. Brown,	1885–91	John T. Meats,	1898–01
Henry F. Lippitt,	1885–88	Charles H. Fish,	1900–01
Wilbur A. Stiles,	1886–88	Herbert E. Walmsley,	1900–01
Stephen N. Bourne,	1886–91	GEO. F. WHITTEN,	1898–
John Kilburn,	1870–80	A. TENNY WHITE,	1899–
William P. Haines,	1874–78	ALFRED E. ADAMS,	1899–
Robert McArthur,	1886–89	W. B. SMITH WHALEY,	1901–
A. M. Wade,	1868–69	Wm. D. HARTSHORNE,	1901–
D. J. Johnston,	1869–70	JAMES R. MacCOLL,	1901–

AUDITORS.

BENJAMIN SAUNDERS,	1865–71	J. HERBERT SAWYER,	1882–00
JOHN C. PALFREY,	1871–73	C. E. ROBERTS,	1900–
HENRY D. SULLIVAN,	1873–82		

SECRETARY AND TREASURER.

AMBROSE EASTMAN,	1865–94	C. J. H. WOODBURY,	1894

MEMBERS OF THE ASSOCIATION.

Sept. 26, 1901.

Members of the Association are respectfully requested to scrutinize the following list, and advise the Secretary, P. O. Box 3672, Boston, Mass., of change in address, or any error in regard to their names.

As a number of members rejoined the Association after severing their first membership, the date of their earliest election is given.

HONORARY MEMBERS.

George Arms	Grand Hotel	New York City	Oct. 16, 1872.
Ambrose Eastman	53 State St., Room 904,	Boston, Mass.	Sept. 27, 1894.
Henry Smith Pritchett, LL.D.,	Pres. Mass. Institute of Technology,	Boston, Mass.	Sept. 26, 1901.
Samuel Webber	Hydraulic Engineer	Charlestown, N. H.	Apr. 28, 1897.

ACTIVE MEMBERS.

Alfred E. Adams	Agt. Whitinsville Cotton Mills Agt. Linwood Mills	Whitinsville, Mass.	Apr. 27, 1887.
John S. Adams, Jr.	Supt. Adams Bros. Mfg. Co. 120 Commercial St.,	Adams, Mass.	Apr. 29, 1896.
Joseph D. Aiken	Asst. Supt. Ponemah Mills	Taftville, Conn.	Oct. 28, 1891.
F. S. Akin	Supt. Cornell Mills	Fall River, Mass.	Sept. 27, 1894.
Charles T. Aldrich	Treas. Aldrich Mfg. Co. Box 34,	Providence, R. I.	Apr. 28, 1886.
Franklin Allen	Supt. Boott Mills	Lowell, Mass.	Oct. 18, 1900.
Frederick K. Allen	Prop. Megunticook Woolen Co.	Camden, Me.	Sept. 26, 1901.
George E. Ames	Mech. Supt. Lawrence Mfg. Co.	Lowell, Mass.	Apr. 24, 1895.
William Ames	Treas. Fletcher Manufg. Co., Box 83, 47 Charles St.,	Providence, R. I.	Apr. 30, 1879.
Charles B. Amory	Treas. Hamilton Manufg. Co. 70 Kilby St.,	Boston, Mass.	Apr. 25, 1894.

Frederic Amory	Treas. Nashua Mfg. Co. and Jackson Mfg. Co. Room 51, Simmons B'l'd., 40 Water St.,	Boston, Mass.	Apr. 27, 1899.
Thomas Armstrong	Supt. No. Pownal Mfg. Co.	No. Pownal, Vt.	Oct. 27, 1897.
Abel T. Atherton	Machine Maker	Bay Side, R. I.	Oct. 16, 1872.
Edward Atkinson	Prest. Boston Mfrs. Mu. Fire Ins. Co. 31 Milk St.,	Boston, Mass.	Apr. 19, 1871.
E. W. Atkinson	Stoddard, Haserick, Richards & Co. 152 Congress St.,	Boston, Mass.	Oct. 27, 1886.
H. C. Atwood	Treas. Williamsville Manufg. Co.	Providence, R. I.	Apr. 29, 1885.
James A. Atwood	Agt. Wauregan Co. and Quinebaug Co.	Wauregan, Conn.	Oct. 28, 1891.
John Walter Atwood	Supt. Wauregan Co.	Wauregan, Conn.	Oct. 24, 1895.
W. E. Atwood	Secy. and Asst. Treas. Williamsville Manufg. Co.	Killingly, Conn.	Sept. 27, 1894.
George A. Ayer	Supt. City Mfg. Corp. / Supt. Bristol Mfg. Corp. 123 Fifth St.,	New Bedford, Mass.	Apr. 24, 1895.
Nathaniel F. Ayer	Asst. Mgr. Farwell Bleachery 56 Summer St.,	Boston, Mass.	Apr. 25, 1901.
Henry A. Bailey	Agt. Chicopee Manufg. Co.	Chicopee Falls, Mass.	Oct. 25, 1893.
Dickerson G. Baker	Mech. Eng., American Thread Co.	Willimantic. Conn.	Oct. 18, 1900.
Edwin H. Baker	Bliss, Fabyan & Co., Box 2899 117 Duane St.,	New York City, N. Y.	Apr. 24, 1878.
Edward R. Ballou	Treas. Ballou Yarn Converting Co., 189 Charles St.,	Providence, R. I.	Apr. 25, 1894.
William P. Bancroft	Vice-Pres. Joseph Bancroft & Sons Co.	Wilmington, Del.	Oct. 31, 1883.
Louis B. Barker	Agt. United States Cotton Co.	Central Falls, R. I.	Apr. 27, 1899.
Lewis E. Barnes	Agt. Pemberton Co. & Methuen Co.,	Methuen, Mass.	Oct. 24, 1895.
William A. Barrell	Agt. Lawrence Duck Co.	Lawrence, Mass.	Apr. 30, 1884.
Thomas Barrett, Jr.	Pres. Langley & Aiken Mills	Augusta, Ga.	Apr. 26, 1900.
Edwin N. Bartlett	Supt. Sigourney and Rockdale Mills,	North Oxford, Mass.	Apr. 29, 1891.
Daniel Moore Bates	Asst. Supt. Joseph Bancroft & Sons Co., Rockford,	Wilmington, Del.	Apr. 28, 1898.
Joseph P. Battles	Treas. and Agt. Lewiston Mach. Co.	Lewiston, Me.	Oct. 24, 1895.
Edward C. Beach	Supt. Gate City Cotton Mills	East Point, Georgia	Oct. 5, 1899.
George W. Bean	Agt. Androscoggin Mills	Lewiston, Me.	Apr. 17, 1872.
Robert Beatty	Robert Beatty & Co. Coral and Adams Sts.,	Philadelphia, Pa.	Oct. 27, 1897.
Truman Beckwith	Treas. Dyerville Manufg. Co. Box 171,	Providence, R. I.	Apr. 27, 1892.
John W. Bell	Asst. Treas. and Mgr. Smith & Dove Manufg. Co.	Andover Mass.	Oct. 27, 1897.
A. C. Bent	Agt. Safety Seamless Pocket Co.	Taunton, Mass.	Oct. 27, 1897.
W. N. Blackstone	Treas. Attawaugan Co. / Treas Totokett Mills Co	Norwich, Conn.	Apr. 29, 1896.
William W. Blades	Gen. Supt. Lorraine Mfg. Co. 135 Mineral Spring Ave.,	Pawtucket, R. I.	Oct. 25, 1893.

T. Ashby Blythe	Proprietor Ashby Cotton Mills	114 Chestnut St., Philadelphia, Pa.	Oct. 27, 1897.
John P. Bodge	Treas. Arkwright Mills	Fall River, Mass.	Oct. 27, 1897.
Jefferson Borden, Jr.	Supt. Fall River Bleachery Co.	Fall River, Mass.	Apr. 27, 1899.
Nathaniel B. Borden	Treas. Barnard Manufg. Co.	Fall River, Mass.	Oct. 15, 1873.
Richard B. Borden	Treas. Richard Borden Mfg. Co. Treas. Troy C. & W. Mfg. Co.	Fall River, Mass.	July 18, 1866.
Thomas J. Borden	326 North Main St.	Fall River, Mass.	Apr. 20, 1865.
E. S. Boss	Agt. Willimantic Linen Co.	Willimantic, Conn.	Oct. 29, 1879.
Henry Deane Bourne	Treas. Hooksett Mfg. Co., 1741 Elm St.	Manchester, N. H.	Oct. 18, 1900.
Stephen N. Bourne	Agt. Dundee Mills	Hooksett, N. H.	Oct. 21, 1869.
Frank A. Bowen	Supt. Appleton Co.	Lowell, Mass.	Apr. 28, 1897.
Arthur F. Brackett	Supt. Royal Arctic & Valley Queen Mills,	Riverpoint, R. I.	Oct. 24, 1895.
A. W. Brainerd	Gen. Mgr. Millville Mfg. Co. and May's Landing Water Power Co.	Millville, N. J.	Apr. 28, 1898.
Ernest Bridge	Supt. Jas. Chadwick & Bro. Ltd.	Jersey City, N. J.	Apr. 24, 1895.
Christopher P. Brooks	Managing Director New Bedford Textile School	New Bedford, Mass.	Apr. 28, 1897.
Henry R. Brown	Supt. Hope Co. and Phenix Mill, Box 56,	Phenix, R. I.	Apr. 28, 1897.
Isaac A. Brown	Treas. Narragansett Mills . Box 324,	Fall River, Mass.	Sept. 29, 1898.
James W. Brown	P. O. Box 312,	Ipswich, Mass.	Oct. 24, 1895.
O. S. Brown	Agt. Salmon Falls Manufg. Co.	Salmon Falls, N. H.	Apr. 21, 1875.
Thomas J. Brown	George Brown's Sons	Mt. Joy, Penn.	Oct. 27, 1897.
E. C. Bucklin	Treas. Interlaken Mills	Butler's Exchange, Box 289, Providence, R. I.	Apr. 25, 1883.
Robert Burgess	Agt. Grinnell Mfg. Corp.	745 County St., New Bedford, Mass.	Apr. 27, 1892.
Edward N. Burke	Lowell Machine Shop	Lowell, Mass.	Apr. 28, 1880.
Alfred H. Burnham	Mgr. Glasgow Mills	Huntington and Jasper Sts., Philadelphia, Pa.	Apr. 26, 1900.
Hervey Burnham	Supt. Beaver Mills and Eclipse Mill	295 Beaver St., North Adams, Mass.	Apr. 27, 1899.
W. R. Burnham		Norwich, Conn.	Apr. 29, 1885.
William D. Cadwell	Agt. Nashua Mfg. Co., 67 Concord St.,	Nashua, N. H.	Apr. 19, 1871.
William H. Cadwell	Agt. Jackson Company	Nashua, N. H.	Apr. 26, 1900.
John P. Campbell	Supt. New York Mills,	New York Mills, Oneida Co., N. Y.,	Sept. 22, 1896.
Byron F. Card	Harding, Whitman & Co.,	78 Chauncy St., Boston Mass.	Apr. 25, 1888.
Samuel A. Carter	Pres. Gate City Cotton Mills	Atlanta, Ga.	Sept. 26, 1901.
George A. Chace	Treas. Bourne Mills	Fall River, Mass.	Apr. 25, 1877.
John W. Chafee	Pres. and Treas. The Sibley Mfg. Co.	Augusta, Ga.	Oct. 18, 1900.
James C. Chalmers	Vice-Pres. Renfrew Mfg. Co.	Adams, Mass.	Oct. 5, 1899.
Simeon B. Chase	Treas. King Philip Mills	Fall River, Mass.	Apr. 21, 1875.

Clarence N. Childs . . Asst. Supt. Hamilton Manufg. Co. . . . . 43 Pine St., Lowell, Mass. . . . Apr. 24, 1895.
Elmer G. Childs . . . Agt. Boston Duck Co. . . . . Bondsville, Mass. . . Oct. 26, 1892.
Jno. H. C. Church . . . Asst. Treas and Sec. Monument Mills, Gt. Barrington, Mass. Apr. 28, 1897.
Ernest E. Clark . . . Mech. Supt. Montreal Cotton Co. . . Valleyfield, P. Q. . . Apr. 29, 1896.
George A. Clark . . . Supt. Manchester Mills . . . . . Manchester, N. H. . Oct. 25, 1882.
Alfred Clarke . . . . Gen'l Mgr. . . . . 23 Central St., Boston, Mass. . . . . Apr. 30, 1879.
E. N. Clemence . . . Sec. and Treas. Eagle & Phenix Mills Columbus, Ga. . . . Apr. 28, 1897.
W. H. Cloher, Jr. . . . Treas. and Agt. Utica Cotton Co. Capron, Oneida Co., N. Y., Sept. 22, 1896.
Josiah G. Coburn . . . . . 99 Washington St., Newton, Mass. . . . Apr. 20, 1865.
Charles H. Collins . . Supt. Berkeley Co. . . . . Ashton, R. I. . . . . Apr. 26, 1900.
John A. Collins . . . . Supt. American Linen Co. . . . . 73 Cottage St., Fall River, Mass. . . Oct. 31, 1883.
B. B. Comer . . . . . Pres. and Treas. Avondale Cotton Mills . . . . . Birmingham, Ala. . . Apr. 26, 1900.
Frank B. Comins . . . Treas. American Moistening Co. . . . . 150 Devonshire St., Room 67, Boston, Mass. . . . . Oct. 28, 1891.
Caesar Cone . . . . . Pres. Proximity Mfg. Co. . . . . Greensboro, N. C. . . Apr. 26, 1900.
John J. Connell . . . . Supt. Cohannet Mills . . . . . Taunton, Mass. . . . Apr. 27, 1892.
Sidney Coolidge . . . Treas. Stark Mills, 50 State St., Room 17 . . . . . Boston, Mass. . . . Sept. 26, 1901.
Peter H. Corr . . . . Treas. Greenwich Bleachery . . . . Taunton, Mass. . . . Apr. 25, 1901.
Frank H. Cotton . . . Mgr. Hope Mills Mfg. Co. . . . Hope Mills, N. C. . . Apr. 27, 1899.
Alphonse S. Covel . . Treas. Tremont and Suffolk Mills, ... P. O. Box 1716, 70 Kilby St., Boston, Mass. . . . Oct. 31, 1877.
William W. Crapo . . Pres. Wamsutta Mills . . . . . New Bedford, Mass. . Sept. 29, 1898.
William J. Cray . . . Supt. Aldrich Mfg. Co. . . . . Moosup, Conn. . . . Apr. 25, 1901.
P. T. Creed . . . . . Agt. Hopewell Mills . . . Box 356, Taunton, Mass. . . . Sept. 22, 1896.
John B. Cudlip . . . . Supt. Gibson Cotton Mill . . . . Marysville, N. Bruns. Apr. 28, 1897.
H. H. Culver . . . . . Supt. Elizabeth Poole Mills . . . . . 39 Ashland St., Taunton, Mass. . . . Apr. 28, 1897.
Henry S. Culver . . . Supt. Westville Cotton Mills . . . . Taunton, Mass. . . . Apr. 28, 1897.
A. G. Cumnock . . . . Treas. Appleton Co. . . . Box 2284, Lowell, Mass. . . . Oct. 28, 1885.
Andrew J. Currier . . Mgr. Valley Falls Co. . . . . Albion, R. I. . . . . Apr. 25, 1888.

T. B. Dallas . . . . { Treas. Phœnix Cotton Mills / Treas. Dallas Manufg. Co. } Box 386, Nashville, Tenn. . Oct. 24, 1895.
Philip Dana . . . . . Supt. Dana Warp Mills . . . . . Westbrook, Me. . . Sept. 29, 1898.
Woodbury K. Dana . . Treas. Dana Warp Mills . . . . . Westbrook, Me. . . . Apr. 25, 1888.
Albert W. Danforth . . Mech. Eng. Shanghai Cot. Cloth Mills, Shanghai, China . . . . . 881 Bridge St., Lowell, Mass. . . . Apr. 27, 1881.
A. Lockwood Danielson Asst. Treas. Quinebaug Co., Box 900, Providence, R. I. . . Sept. 27, 1894.
J. DeForest Danielson { Asst. Treas. Lockwood Co. & Lewiston Bleachery & Dye Works } Providence, R. I. . . Sept. 27, 1894.
John W. Danielson . . Treas. Lockwood Co. and Ponemah Mills . . . . . Box 900, Providence, R. I. . . Jan. 15, 1868.

B. D. Davol	Pres. Barnard Mfg. Co.	P. O. Box 418, Fall River, Mass.	Apr. 25, 1877.
Albert Deabill	Supt. Lowell Hosiery Co.,	Mt. Vernon St. Lowell, Mass.	Apr. 25, 1901.
James C. Deane	Vice-Pres. Mass. Tool Co.	19 High St., Greenfield, Mass.	Apr. 25, 1894.
Augustus De Cort	Treas. Beacon Mfg. Co.,	P. O. Box 2815 Boston, Mass.	Apr. 26, 1900.
George DeForest	Treas. Utica Steam Cotton Mills	Utica, New York	Oct. 27, 1897.
William P. Dempsey	Treas. Dempsey Bleachery and Dye Works,	Pawtucket, R. I.	Apr. 28, 1886.
Charles W. Dennett	Vice Pres. and Agt. Johnson-Dunbar Mills Co.	North Adams, Mass.	Oct. 29, 1890.
Edward P. Dennis	Lowell Machine Shop	Lowell, Mass.	Apr. 25, 1888.
Charles A. Denny	Pres. American Card Clothing Co.	Leicester, Mass.	Apr. 25, 1888.
P. Y. DeNormandie	Treas. Pepperell Mfg. Co. 30 Kilby St.,	Boston, Mass.	Apr. 29, 1896.
Charles Owen Dexter	Mgr. Canadian Col'd Cotton Mills Co. Ltd.	Hamilton, Ont., Can.	Apr. 24, 1895.
Henry C. Dexter,	Agt. and Sec. Greene & Daniels Mfg. Co.	Pawtucket, R. I.	Apr. 25, 1901.
Lewis Dexter, Jr.	Mgr. The Canadian Colored Cotton Mills Co., Ltd.	Milltown, N. B.	Apr. 27, 1899.
Samuel Dibble	Pres. Enterprise Cotton Mills,	Orangeburg, S. C.	Sept. 29, 1898.
F. Dilling	Pres. Dilling Cotton Mills	Kings Mountain, N. C.	Oct. 24, 1895.
Albert W. Dimick	Supt. Fisher Mfg. Co.	Fisherville, Mass.	Apr. 25, 1894.
Bradford C. Divine	Supt. Utica Willow Vale Bleaching Co.	Chadwicks, N. Y.	Apr. 27, 1899.
Robert Dow,	Partner in Solway Mills,	Westerly, R. I.	April 25, 1901.
Eben S. Draper	Agt. Draper Co.	Hopedale, Mass.	Oct. 31, 1888.
George A. Draper	Treas. Draper Co.	Hopedale, Mass.	Oct. 31, 1888.
George Otis Draper	Sec'y Draper Co.	Hopedale, Mass.	Apr. 24, 1895.
William F. Draper	Pres. Draper Co.	Hopedale, Mass.	July 17, 1867.
William F. Draper, Jr.	Draper Co.	Hopedale, Mass.	Oct. 29, 1890.
Frederic C. Dumaine,	Treas. Amory Mfg. Co., Box 2879 64 Ames Building,	Boston, Mass.	April 25, 1901.
T. C. Duncan	Pres. and Treas. Union Cotton Mills	Union, S. C.	Apr. 26, 1900.
Joseph M. Dunham	43 Edwards St.,	Springfield, Mass.	Oct. 26, 1892.
Frank H. Dwelly	Treas. Tecumseh Mills	Fall River, Mass.	Apr. 27, 1899.
David H. Dyer	D. H. Dyer & Son, Mill Engineers, P. O. Box 582, 6, 7 and 8 Pocassett Bank Building,	Fall River, Mass.	Oct. 18, 1871.

Benjamin M. Earle	Prop. Merchants Dye Works	Walnut Hill, Mass.	Sept. 26, 1901.
William A. Eastman	Treas. Lowell Hosiery Co.	Lowell, Mass.	Apr. 24, 1878.
Russell W. Eaton	Agt. Cabot Manufg. Co.	Brunswick, Me.	Oct. 26, 1887.
John Eccles	Agt. Ponemah Mills	Taftville, Conn.	Apr. 27, 1892.
Lawrence V. Elder	Man. Dir. Galveston City Cotton Mills 212 Tremont St.,	Galveston, Texas	Oct. 27, 1886.
Oscar Elsas	Vice-Pres. Fulton Bag & Cotton Mills, P. O. Box 773,	Atlanta, Ga.	Apr. 28, 1897.
Frederick W. Ely	Agt. Columbian Manufg. Co.	Greenville, N. H.	Apr. 25, 1888.

Charles Estes	Vice-Pres. John P. King Mfg. Co.	Augusta, Ga.	Apr. 26, 1900.
H. B. Estes	Agt. Continental Mills	Lewiston, Me.	Apr. 26, 1893.
William Evans	Treas. Wampanoag Mills	Fall River, Mass.	Apr. 29, 1896.
Herbert R. Farnum	Supt. Bernon Mills	Georgiaville, R. I.	Apr. 27, 1881.
Charles F. Farrar	22 Coggeshall St.,	Fall River, Mass.	Oct. 27, 1897.
George E. Farrell	Treas. Utica Spinning Co.	Utica, N. Y.	Oct. 18, 1900.
James T. Ferguson	Supt. Warwick Mills	Centreville, R. I.	Oct. 5, 1899.
Frank S. Field	Supt. & Agt. Massaemit Yarn Mills	Shattuckville, Mass.	Oct. 24, 1895.
William Firth	Pres. American Moistening Co. & Wm. Firth Co. P. O. Box 1460, 150 Devonshire St., Room 67,	Boston, Mass.	Apr. 25, 1888.
Charles H. Fish	Agt. Cocheco Manufg. Co.	Dover, N. H.	Apr. 27, 1887.
Charles W. Fisher,	Asst. Supt. Fisher Mfg. Co.	Fisherville, Mass.	Apr. 25, 1901.
Henry E. Fisher	Vice-Pres. & Agt. Atlanta Cotton Mills	Atlanta, Ga.	Oct. 24, 1895.
Herbert Fisher		Taunton, Mass.	Oct. 29, 1879.
William B. Fitz	Agt. W. Boylston Mfg. Co.	Easthampton, Mass.	Oct. 26, 1892.
Frederick A. Flather	Mech. Engineer & Foreman Lowell Machine Shop	Lowell, Mass.	Apr. 29, 1891.
F. C. Fletcher	Vice Pres. Lawton Spinning Co. 621 Banigan Building,	Providence, R. I.	Oct. 18, 1900.
M. F. Foster		Milford, N. H.	Apr. 17, 1872.
Philip H. Fowler	417 Monmouth St.,	Gloucester City, N. J.	Nov. 30, 1881.
Edward W. France	Dir. of Philadelphia Textile School, 320 So. Broad St.,	Philadelphia, Pa.	Sept. 22, 1896.
Arthur C. Freeman	Supt. Clear Water Bleachery and Mfg. Co. Box 208,	Augusta, Ga.	Apr. 27, 1899.
John W. Fries	Managing Partner, F. & H. Fries,	Winston-Salem, N. C.	Oct. 18, 1900.
C. H. Frisbie	Agt. Attawaugan Co.	Norwich, Conn.	Oct. 29, 1890.
W. T. Galey	Pres. Aberfoyle Manufg. Co.	Chester, Pa.	Apr. 28, 1897.
William Gammell	Agt. Berkeley Co.	Providence, R. I.	Oct. 28, 1885.
James G. Garland		Saco, Me.	Oct. 29, 1879.
Edward T. Garsed	Treas. Hucomuga Mills	Greensboro, N. C.	Apr. 28, 1898.
Joshua Garsed	Wingohocking Mills and National Spinning Co., Frankford	Philadelphia, Pa.	Oct. 27, 1897.
James A. Gary	Alberton Mills	108 German St., Baltimore, Md.	Apr. 25, 1883.
James Gee	Supt. Interlaken Dye Works	Fiskville, R. I.	Apr. 28, 1898.
Charles E. Getchell	Supt. Waltham Bleachery and Dye Works P. O. Box 62, 35 Willow St.,	Waltham, Mass.	Oct. 30, 1889.
William C. Godfrey	Agt. Indian Orchard Co.	Indian Orchard, Mass.	Oct. 29, 1890.
Alfred M. Goodale	Treas. Boston Manufg. Co. 50 State St.,	Boston, Mass.	Apr. 25, 1883.
Louis B. Goodall	Treas. Goodall Worsted Co.	Sanford, Me.	Oct. 5, 1899.
Frederick B. Gordon	Pres. Columbus Mfg Co.	Columbus, Ga.	Apr. 26, 1900.
Charles H. Gorton	Supt. Columbus Mfg. Co.	Columbus, Ga.	Apr. 25, 1894.

Marcellus Gould . . . Pres. and Mgr. N. H. Spinning Mills, Penacook, N. H. . . Sept. 22, 1896.
George P. Grant, Jr. . . Treas. Grant Yarn Co. . . . . Fitchburg, Mass. . . Sept. 27, 1894.
D. W. Gray . . . . . Supt. Skenandoa Cotton Co. . . . . Utica, N. Y. . . . . Oct. 26, 1892.
R. A. Gray . . . . . Supt. Rodman Manufg. Co. . . . . Allenton, R. I. . . . Apr. 24, 1895.
Stephen Greene . . . Mill Architect and Engineer Lockwood, Greene & Co. . . .
. . . . . 93 Federal St., Boston, Mass. . . . Oct. 27, 1886.
Joseph Warren Greene . Supt. Hamilton Web Co. . . . . Hamilton, R. I. . . . Apr. 29, 1896.
William C. Greene . . Treas. Peace Dale Manufg. Co. . . Peace Dale, R. I. . . Oct. 27, 1886.
William H. Greene, . . Treas. Greene & Daniels Mfg. Co., . Pawtucket, R. I. . . Apr. 25, 1901.
John T. Greenwood . . R. Greenwood & Bault . . . . . .
. . . . . 4720 Leiper St., Frankford, Philadelphia, Pa. . . Apr. 26, 1900.
S. Greenwood . . . . Mgr. Canadian Col'd Cot. Mills Co. Ltd. . . . . .
. . . . . Cornwall, Ontario . . Oct. 5, 1899.
John Gregson . . . . Agt. Fiskdale Mills . . . . . Fiskdale, Mass. . . . Apr 24, 1895.
Maxwell Grierson . . . Gen. Mgr. Jas. Chadwick & Bro., Ltd., Jersey City, N. J. . . Apr. 28, 1898.
Frederick Grinnell . . Pres. Gen. Fire Extinguisher Co. . . New Bedford, Mass. . Apr. 24, 1878.
David Grove . . . . . Supt. U. S. Cotton Co. . . . . Central Falls, R. I. . Apr. 28, 1898.
Henry S. Grove . . . Pres. Argo Mills Co., ...
. . . . . 216 Chestnut St., Philadelphia, Pa. . . Apr. 28, 1898.
Arthur H. Gulliver . . Agt. Boston Mfg. Co. . . . . Waltham, Mass. . . Apr. 24, 1889.
B. F. Guy . . . . . Gen. Supt. Pelzer Manufg. Co. . . . Pelzer, S. C. . . . . Apr. 24, 1895.

William J. Hadfield . . Newburgh Steam Mills, ...
. . . . . 236 Montgomery St., Newburgh, N. Y. . . Apr. 27, 1899.
Frank J. Hale . . . . Gen. Agt. Saco and Pettee Machine Shops . . . . . .
. . . . . Newton Upper Falls, Mass. . Apr. 27, 1892.
Walter B. Hall . . . . Supt. Pontiac Mill, B. B. & R. Knight, Pontiac, R. I. . . . . Apr. 25, 1901.
William E. Hall . . . Treas. Shaw Stocking Co. . . . . Lowell, Mass. . . . Apr. 27, 1892.
Z. D. Hall . . . . . Supt. Berkshire Cotton Mfg. Co. . . . . .
. . . . . 70 Orchard St., P. O. Box 963, Adams, Mass. . . . Oct. 29, 1879.
William Halliwell, . . Supt. Lawton Spinning Co., ... Woonsocket, R. I. . Sept. 26, 1901.
John H. Hambly . . . Treas. Quidnick Manufg. Co. . . . . .
. . . . . 49 Westminster St, Providence, R. I. . . Apr. 24, 1895.
Arthur M. Hamilton . . Supt. Hargraves and Parker Mills . . . . . .
. . . . . 362 Linden St., Fall River, Mass. . . Apr. 28, 1897.
John F. Hamlet . . . Manufacturer . . . P. O. Box 160, Fall River, Mass. . . Oct. 31, 1888.
Joseph O. Hannum . . Agt. Indian Head Mills of Alabama Cordova, Ala. . . . Apr. 30, 1890.
A. G. Harris, ... Supt. W. H. Draper & Son, ...
. . . . . 10 Third St., Upper Troy, N. Y. . Sept. 26, 1901.
Henry F. Harris . . . Treas. West Boylston Manufg. Co. . . . . .
. . . . . 340 Main St., Worcester, Mass. . . Apr. 30, 1890.
John J. Hart . . . . . Pres. and Gen. Mgr. Charlton Manufg. Co. . . . . .
. . . . . P. O. Box 94, Pawtucket, R. I. . . Apr. 24, 1895.
William D. Hartshorne Agt. Arlington Mills . . . . . Lawrence, Mass. . . Apr. 27, 1899.
Samuel E. Hathaway . Supt. Fall River Iron Works Co. . . Fall River, Mass. . . Sept. 27, 1894.
William Hathaway . . Supt. Barnard Manufg. Co. . . . . Fall River, Mass. . . Apr. 25, 1894.

William B. Hawes . . Yarn Broker . . . 108 Bedford St., ... P. O. Box 733, Fall River, Mass. Oct. 24, 1895.
Alfred Hawkesworth . Supt. Merchants' Cotton Co. . . . . Montreal, P. Q. . . . Apr. 26, 1893.
Fred Hawkesworth . . Asst. Supt. Merchants' Cotton Co. . Montreal, P. Q. . . . Sept. 22, 1896.
William Hayes . . . . Agt. Barker Mill . . . . . Auburn, Me. . . . . Apr. 30, 1879.
W. G. Henderson . . . Agt. Shetucket Co. . . . . Norwich, Conn. . . . Apr. 29, 1896.
A. E. Henry, ... Mfr. Partner in Solway Mills, . . . Westerly, R. I. . . . Apr. 25, 1901.
T. I. Hickman, ... Pres. and Treas. Graniteville Mfg. Co. . . . . Leonard Bldg., Augusta, Ga. . . . . Apr. 25, 1901.
William R. Hill . . . Treas. Glasgow Manufg. Co. . . . . South Hadley Falls, Mass. Oct. 25, 1893.
George H. Hills . . . Treas. Davol Mills & Stevens Mfg. Co. . Fall River. Mass. . Oct. 24, 1895.
Charles H. Hobbs . . Agt. Thorndike Co. . . . . Thorndike, Mass. . . . Apr. 28, 1886.
Franklin W. Hobbs . . Asst. Treas. Arlington Mills . . . . . P. O. Box 3590, 78 Chauncy St., Boston, Mass. . . . Apr. 27, 1899.
Louis L. Hohn . . . . . 122 High St., Westerly, R. I. . . . Apr. 28, 1897.
Charles M. Holmes . . Supt. Natick Mills . . . . . Natick, R. I., . . . Apr. 27, 1899.
Gideon F. Holmes . . Treas. and Gen. Mgr. Plymouth Cor- . . . . . dage Co. . . . . No. Plymouth, Mass. . Oct. 30, 1889.
George W. Holt . . . Agt. Monohansett Manufg. Co. . . Putnam, Conn. . . . Oct. 29, 1879.
Walter L. Holt . . . . Pres. Holt-Morgan Mills . . . . . Fayetteville, N. C. . . Oct. 18, 1900.
William P. Holt . . . Supt. Barnaby Mills . . . . . Fall River, Mass. . . Oct. 25, 1893.
Thomas Horsfield . . . . . 95 Bonney St., New Bedford, Mass. . Oct. 27, 1897.
Henry S. Houghton, Jr. Supt. Paul Whitin Manufg. Co. . . Northbridge, Mass. . Apr. 24, 1895.
W. C. Houston . . . . Pres. Hope Mills Manufg. Co. . . . . 33 Drexel Building, Philadelphia, Pa. . . Apr. 28, 1897.
Elisha H. Howard . . Treas. Harris Textile Co. . . . . 309 Butler Exchange, Providence, R. I. . . . Apr. 25, 1883.
Henry S. Howe . . . . Dry Goods Commission, 68 Chauncy St., Boston, Mass. . Oct. 31, 1877.
Albert C. Hoy . . . . Asst. Supt. Hamlet Mills . . . . . Woonsocket, R. I. . . Apr. 28, 1898.
Charles W. Hubbard . Treas. Ludlow Mfg. Co., ... 133 Essex St., Boston, Mass. . . . Apr. 25, 1901.
W. S. Hume . . . . . Supt. Dominion Cotton Mills, Ltd. . . . . 176 Notre Dame St., Hochelaga, P. Q., Can. Oct. 29, 1890.
Otis L. Humphrey, . . Cotton Dept. Lowell Textile School, Lowell, Mass. . . . Apr. 25, 1901.
A. W. Hunking . . . . . 374 Stevens St., Lowell, Mass. . . . Apr. 24, 1895.
George A. Hurd, . . . Supt. Cocheco Mfg. Co. . . . . Dover, N. H. . . . . Apr. 25, 1901.

D. Edwin Irving . . . Treas. The Irving & Leiper Mfg. Co., Chester, Pa. . . . . Oct. 27, 1897.

J. E. Jenckes . . . . . Treas. E. Jenckes Manufg. Co. . . Pawtucket, R. I. . . Apr. 24, 1895.
Edward B. Jennings . . Treas. Samoset Co. . . . . Valley Falls, R. I. . . Sept. 29, 1898.
David L. Jewell . . . Agt. China, Webster & Pembroke Mills . Suncook, N. H. . Apr. 20, 1865.
David S. Johnston . . Treas. Cohoes Iron Foundry & Mach. Co., Cohoes, N. Y. . Oct. 28, 1891.
W. T. Jordan . . . . Mgr. Mountain Island Mfg. Co. . . Mountain Island, N. C. Oct. 24, 1895.

Frank E. Kaley . . . . Treas. Morse & Kaley Mfg. Co. . . Milford, N. H. . . . Oct. 24, 1895.
W. E. Keach . . . . . Supt. Grant Yarn Co. . 123 Myrtle Ave., Fitchburg, Mass. Oct. 26, 1892.
Roland R. Kelly . . . Supt. Williamstown Manufg. Co. . Williamstown Sta., Mass. Nov. 30, 1881.
George E. Kent . . . . Treas. Exeter Manufg. Co. & Prop. Pittsfield Mills . . . .
. . . . . Pittsfield, N. H. . . Oct. 31, 1888.
Hervey Kent . . . . . Pres. Exeter Manufg. Co. . . . . Exeter, N. H. . . . Apr. 20, 1865.
Nathaniel B. Kerr . . . Agt. Boott Cotton Mills . . . . . Lowell, Mass. . . . Oct. 26, 1892.
John Kilburn . . . . . Belmont, Mass. . . . Apr. 20, 1865.
Harry W. Kimball . . Supt. Fulton Bag & Cotton Mills . Atlanta, Ga. . . . . Oct. 24, 1895.
Benjamin B. Kirk . . . Supt. Fall River Iron Works Co. . . Fall River, Mass. . . Apr. 28, 1897.
Albert Knight . . . . Supt. Quidnick Mills . . . . . Quidnick, R. I. . . . Apr. 24, 1895.
Albert F. Knight . . . . . 39 Main St., Woonsocket, R. I. . . Oct. 27, 1886.
C. Prescott Knight . . B. B. & R. Knight's Mills . . . . River Point, R. I. . . Sept. 29, 1898.
Jesse A. Knight . . . . Sec'y & Supt. Lawton Spinning Co. Providence, R. I. . . Oct. 26, 1892.
Stephen A. Knight . . Pres. Hebron Manufg. Co., Box 820, Providence, R. I. . . Oct. 21, 1868.
Walter B. Knight . . . Reynolds Manufg. Co. . . . . Davisville, R. I. . . Apr. 24, 1889.
Webster Knight . . . B. B. & R. Knight's Mills . . . . . .
. . . . . 3 Washington Row, Providence, R. I. . . Sept. 29, 1898.

Fred Lacey . . . . . Mgr. Montreal Cotton Co. . . Valleyfield, P. Q. . . . . Apr. 24, 1895.
William T. Lang . . . Agt. Brookside Mills . . . . . Knoxville, Tenn. . . Apr. 28, 1897.
Walter H. Langshaw . Agt. Dartmouth Manufg. Corp. . . New Bedford, Mass. . Apr. 29, 1896.
Elliott Cowdin Lambert Supt. Amoskeag Manufg. Co. . . . Manchester, N. H. . Oct. 24, 1895.
George H. Law . . . Supt. Merchants' Mfg. Co. . . . . .
. . . . . 815 Walnut St., Fall River, Mass. . . Apr. 28, 1897.
Harold Lawton . . . . Gen. Mgr. Baltic Mills Co. . . . . Baltic, Conn. . . . . Oct. 27, 1886.
John Edward Lawton . Governing Director American Thread Co. . . . . .
. . . . . Matlock, Derbyshire, England . Apr. 25, 1901.
Evan Arthur Leigh . . Textile Machinery . . 70 Kilby St., Boston, Mass. . . . Oct. 29, 1890.
John Leiper . . . . . Supt. Fitchburg Worsted Mills, Upland Road . . . . . .
. . . . . 171 Blossom St., Fitchburg, Mass. . . Oct. 27, 1897.
J. Colby Lewis . . . . Supt. & Mgr. Vesta Cotton Mills, . . Charleston, S. C. . . Oct. 26, 1892.
Leontine Lincoln . . . Pres. Seaconnet Mills . . . . . Fall River, Mass. . . Apr. 28, 1897.
B. F. G. Linnell . . . Commission Merchant, Yarns, Threads and Twines . . .
. . . . . P. O. Box 645, Central Falls, R. I. . . Oct. 27, 1897.
Charles Warren Lippitt, Treas. Silver Spring B. & D. Co. . . Providence, R. I. . . Oct. 30, 1878.
Henry F. Lippitt . . . Agt. Social and Manville Cos. . . . Providence, R. I. . . Apr. 27, 1881.
William H. Loftus . . Supt. Clark Thread Co. . . . . Newark, N. J. . . . Oct. 27, 1897.
Robert W. Lord . . . Agt. R. W. Lord & Co. . . . . Kennebunk, Me. . . Oct. 20, 1869.
Ernest Lovering . . . Agt. Lyman Mills . . . . . Holyoke, Mass. . . . Apr. 25, 1888.
Henry M. Lovering . . Agt. Whittenton Manufg. Co. . . . Taunton, Mass. . . . Oct. 27, 1880.
William C. Lovering . Pres. Whittenton Mfg. Co., . . 40 Water St., Boston, Mass. Oct. 25, 1876.
William M. Lovering . Supt. Whittenton Manufg. Co. . . . Taunton, Mass. . . . Sept. 27, 1894.
Arthur H. Lowe . . . Treas. Parkhill Manufg. Co. . . . . Fitchburg, Mass. . . Oct. 30, 1889.
David Lowe . . . . . Asst. Supt. Parkhill Manufg. Co. . . Fitchburg, Mass. . . Apr. 24, 1895.

A. Lawrence Lowell	Trustee, Lowell School of Design, 843 Exchange Bldg.,	Boston, Mass.	Apr. 25, 1901.
Dudley T. Lyall	Asst. Mgr. Brighton Mills	Passaic, N. J.	Sept. 22, 1896.
William L. Lyall	Supt. J. & W. Lyall Loom and Machine Works and Sec. Brighton Mills	Passaic, N. J.	Oct. 26, 1892.
Herbert Lyman	505 Sears Bldg., Box 1717,	Boston, Mass.	Oct. 24, 1895.
Otis G. Lynch	Supt. Enterprise Manufg. Co.	Augusta, Ga.	Oct. 24, 1895.
Alvin S. Lyon	Supt. Bigelow Co.	Lowell, Mass.	Apr. 26, 1882.
James R. MacColl	Treas. Lorraine Manufg. Co.	Pawtucket, R. I.	Apr. 24, 1895.
Charles L. Macomber	Pres. Winthrop Cotton Yarn Co.	Taunton, Mass.	Apr. 24, 1895.
Frederick B. Macy,	Treas. Soule Mills,	New Bedford, Mass.	Apr. 25, 1901.
Amos G. Maddox	Supt. Linwood Mill	Linwood, Mass.	Oct. 18, 1900.
Charles T. Main	Mech. and Mill Engineer Dean & Main 53 State St., 1112 Exchange Bldg.,	Boston, Mass.	Oct. 28, 1885.
Charles R. Makepeace	Mill Engineer Box 973,	Providence, R. I.	Apr. 30, 1890.
A. T. Malcolmson	Agt. C. Bischoff & Co. 19 George St., Box 1104,	Providence, R. I.	Oct. 27, 1897.
Arthur B. Mann	J. H. Martin & Co., Box 465, 99 Franklin St.,	New York, N. Y.	Apr. 25, 1894.
Charles H. Manning	Supt. Amoskeag Manufg. Co.	Manchester, N. H.	Oct. 28, 1885.
Henry F. Mansfield	Gen. Supt. Utica Steam Cotton Mills and Mohawk Valley Cotton Mills	Utica, N. Y.	Apr. 30, 1890.
Paul J. Marrs	Treas. Henderson Cotton Mills	Henderson, Ky.	Oct. 27, 1897.
Albert G. Martin	Supt. Kincaid Manufg. Co. Box 182, Griffin,	Spalding County, Ga.	Apr. 30, 1884.
Henry D. Martin		West Acton, Mass.	Apr. 28, 1897.
John R. Mason	523 Broadway,	Fall River, Mass.	Apr. 28, 1897.
Philip A. Mathewson	Supt. King Philip Mills	Box 607, Fall River, Mass.	Apr. 24, 1895.
Scott Maxwell,	Supt. Lanett Mills	West Point, Ga.	Sept. 26, 1901.
Thomas Mayor	Textile Machinery Thomas Mayor & Son, 26 Olney St.,	Providence, R. I.	Oct. 27, 1880.
Robert McArthur	Agt. Pepperell Mfg. Co.	Biddeford, Me.	Apr. 17, 1872.
Thos. McAulifie	Supt. Stevens Mfg. Co.	Fall River, Mass.	Apr. 28, 1898.
Charles D. McDuffie	Agt. Manchester Mills	Manchester, N. H.	Apr. 21, 1869.
Fred C. McDuffie	Treas. Everett Mills and York Manufg. Co.	P. O. Box 2934, 40 Water St., Boston, Mass.	Oct. 25, 1882.
William G. McLoon	Supt. Lancaster Mills,	Clinton, Mass.	Apr. 27, 1892.
Robert G. McMeehan,	Supt. Hamlet Textile Co.	Woonsocket, R. I.	Sept. 26, 1901.
William P. McMullan	Agt. Naumkeag Steam Cotton Co.	Salem, Mass.	Sept. 27, 1894.
John Tempest Meats	Agt. Mason Machine Works	Taunton, Mass.	Apr. 27, 1887.
Henry P. Meikleham,	Agt. Mass. Mills in Georgia	Lindale, Floyd Co., Ga.	Apr. 26, 1900.
Charles H. Merriman, Jr.	Social Mfg. Co.	Providence, R. I.	Apr. 24, 1895.
Frank M. Messenger	Agt. Grosvenor Dale Co.	No. Grosvenor Dale, Conn.	Apr. 27, 1887.
W. H. Miles	Agt. Farwell Mills	Lisbon, Me.	Sept. 22, 1896.
R. M. Miller, Jr.	Pres. & Treas. Elizabeth Mills	Charlotte, N. C.	Sept. 29, 1898.

James I. Milliken . . . Agt. Everett Mills . . . . . Lawrence, Mass. . . Oct. 26, 1892.
Roscoe S. Milliken . . Supt. Nashua Mfg. Co. . . . . Nashua, N. H. . . . Apr. 29, 1896.
David Milne . . . . . C. J. Milne & Sons . . . . . Washington Ave. & 11th St., Philadelphia, Pa. . . Apr. 28, 1897.
A. B. Mole . . . . . Mgr. Greylock Mill . . . . . Adams, Mass. . . . Apr. 24, 1895.
Edward A. Mongeon . Supt. Lonsdale Cos. Mills . . . . Lonsdale, R. I. . . . Apr. 24, 1895.
J. R. Montgomery . . Pres. The J. R. Montgomery Co. . . Windsor Locks, Conn. Sept. 29, 1898.
George A. Moody . . Supt. West Warren Cotton Mills . . West Warren, Mass. . Apr. 27, 1899.
James Sumter Moore . Sec. and Treas. Olympia & Richland Cotton Mills . . . . Columbia, S. C. . . . Apr. 26, 1900.
Fred W. Moore . . . Agt. Cordis Mills . . P. O. Box 582, Millbury, Mass. . . . Apr. 27, 1892.
Albert H. Morton . . . Supt. Kitson Machine Co. . . . . Lowell, Mass. . . . Oct. 28, 1891.
E. P. Morton, ... Agt. Stevens Linen Works . . . . Webster, Mass. . . . Sept. 26, 1901.
Oliver H. Moulton . . Supt. Hamilton Manufg. Co. . . . Lowell, Mass. . . . Apr. 20, 1865.
Farquharson J. Muir . Supt. Canadian Col'd Cot. Mills Co., Ltd., St. Croix Mill . . Milltown, N. B., Can. Apr. 27, 1892.

John Neild . . . . . Supt. Soule Mills . . . . . New Bedford, Mass. . Apr. 25, 1901.
Roscius C. Newell . . . Supt. Palmer Mill . . . . . Three Rivers, Mass. . Oct. 24, 1895.
William G. Nichols . . Sec. and Treas. Springstein Mills . Chester, S. C. . . . . Oct. 25, 1893.
William M. Nixon . . . Pres. Atlanta Woolen Mills . . . . Atlanta, Ga. . . . . Oct. 5, 1899.
Albert W. Noone, . . . Prop. & Mgr. Jos. Noone's Son's Co. Peterboro, N. H. . . Sept. 26, 1901.
Franklin Nourse . . . Agt. Lawrence Manufg. Co. . . . . Lowell, Mass. . . . Apr. 24, 1878.

S. Odenheimer . . . . Treas. Lane Mills . . . . . New Orleans, La. . . Oct. 25, 1893.
Charles K. Oliver . . . Treas. Mt. Vernon-Woodberry Cotton Duck Co. . . . . 346-8 Equitable Bldg., Baltimore, Md. . . . Sept. 27, 1894.
J. Edward Osborn . . . Treas. American Linen Co. . . . . Fall River, Mass. . . Apr. 28, 1897.
Henry Osgood, ... P. O. Box 204, Salem, Mass. . . . . Apr. 25, 1901.
Herbert W. Owen . . Asst. Supt. Merchants' Mfg. Co. . Fall River, Mass. . . Oct. 5, 1899.
Oscar L. Owen . . . . Mech. and Mill Eng. Whitin Machine Works . . . . . Whitinsville, Mass. . Apr. 25, 1894.

Elmer E. Page . . . . Agt. York Manufg. Co. . . . . Saco, Me. . . . . Apr. 27, 1892.
Francis J. Parker . . . Treas. Monadnock Mills, 81 Milk St., Boston, Mass. . . . Jan. 15, 1868.
O. B. Parker . . . . . Supt. Laurens Cotton Mills . . . . Laurens, S. C. . . . Apr. 24, 1895.
Samuel L. Parker . . . Supt. Turners Falls Cotton Mills . . . . . Box 627, Turners Falls, Mass. . Apr. 29, 1896.
Walter E. Parker . . . Agt. Pacific Mills, 217 Haverhill St., Lawrence, Mass. . . Apr. 25, 1877.
John H. Parks . . . . Pres. Wm. Parks & Son, Ltd. . . . St. John, N. B. . . . Apr. 24, 1878.
Duncan D. Parmly . . Treas. Johnson Mfg. Co. and Dunbar Mills Co. . . . . 160 Broadway, New York, N. Y. . . Sept. 22, 1896.
Samuel F. Patterson . . Pres. and Treas. Thistle Mills Co. . Ilchester, Md. . . . Oct. 18, 1900.
John W. Pead . . . . Agt. Merrimack Manufg. Co. . . . . Box 1231, Lowell, Mass. . . . . Apr. 26, 1893.

James R. Pearce . . . Supt. Chewalla Cotton Mill . . . . Eufaula, Ala. . . . . Oct. 24, 1895.
William C. Peirce . . . Pres. Elizabeth Mills . 564 Eddy St., Providence, R. I. . . . Apr. 24, 1895.
William D. Pennell . . Agt. Hill Manufg. Co. . . . . Lewiston, Me. . . . Apr. 16, 1873.
Haven C. Perham . . . Treas. Kitson Machine Co. . . . . Lowell, Mass. . . . Apr. 30, 1879.
Henry C. Phillips . . . Supt. Greylock Mills, ... North Adams, Mass. Apr. 25, 1894.
Benjamin Phipps . . . Merchant . . . . . 4 Winthrop Sq. Boston, Mass. . . . Sept. 29, 1898.
Albert R. Pierce . . . Supt. Pierce Mfg. Corp. . . . . New Bedford, Mass. . Oct. 5, 1899.
Andrew G. Pierce, Jr. { Treas. Rotch Spinning Co. . . . / Treas. Pierce Manufg. Corp. . . / Treas. Howland Mills Corp. . . . } P. O. Box, 34, . . . New Bedford, Mass. . Apr. 24, 1895.
Reuben Pilling, Jr. . . . . 30 Hudson St., Providence, R. I. . . . Apr. 29, 1896.
Charles H. Plummer . . Agt. Great Falls Manufg. Co. . . . Somersworth, N. H. . Apr. 25, 1888.
Charles T. Plunkett . . Sec. Berkshire Cotton Mfg. Co. . . Adams, Mass. . . . Apr. 28, 1897.
Charles H. Potter, . . . Supt. Montreal Cotton Co., ... Valleyfield, P. Q., . . Apr. 25, 1901.
Joseph H. Potter, Jr. . Supt. Durfee Mills . . . . . Fall River, Mass. . . Apr. 27, 1899.
J. F. Powers . . . . . Supt. Eagle Mill . . . . . North Adams, Mass. Oct. 5, 1899.
Herbert L. Pratt . . . Agt. Bates Manufg. Co. . . . . Lewiston, Me. . . . Oct. 27, 1875.
T. W. Pratt . . . . . Pres. West Huntsville Cotton Mill Co. . . . . Huntsville, Ala. . . . Sept. 22, 1896.
John E. Prest . . . . Gen. Supt. Harmony Mills . . . . Cohoes, N. Y. . . . Apr. 17, 1872.

M. W. Quinn . . . . . Agt. Hamilton Woolen Co. . . . . Amesbury, Mass. . . Oct. 27, 1886.

T. G. Ramsdell . . . . Agt. Monument Mills . . . . . Housatonic, Mass. . . Oct. 30, 1878.
Emory S. Rathbun . . Supt. Pequot Mills . . . . . Montville, Conn. . . Apr. 27, 1899.
M. A. Rawlinson . . . Supt. Tremont and Suffolk Mills . . Lowell, Mass. . . . Apr. 24, 1895.
John F. Reardon . . . Agt. Falls Co. . . . . Norwich, Conn. . . . Apr. 26, 1900.
Robert Redford . . . Mfr. . . . . Box 28, Lawrence, Mass. . . Apr. 26, 1882.
R. S. Reinhardt . . . . Treas. and Mgr. Elm Grove Cotton Mills Lincolnton, N. C. Apr. 28, 1898.
L. B. Renfrew . . . . Treas. Renfrew Mfg. Co. . . . . Adams, Mass. . . . Oct. 5, 1899.
T. H. Rennie . . . . . Supt. Graniteville Mfg. Co. . . . . Graniteville, S. C. . . Oct. 18, 1900.
Frederick W. Reynolds, Supt. Potomska Mills, ... Box 299, ... 20 Fifth St., New Bedford, Mass. . Apr. 26, 1900.
F. H. Rice . . . . . Care of Henry F. Harris, ... 340 Main St., Worcester, Mass. . . Apr. 28, 1880.
Charles H. Richardson Agt. Lancaster Mills . . . . . Clinton, Mass. . . . Apr. 24, 1889.
W. H. Richmond . . . Supt. Bibb Mill No. 2 . . . . . Macon, Ga. . . . . Oct. 27, 1897.
Walter Rigby . . . . Supt. Ballou Yarn Converting Co. . . . . 189 Charles St., Providence, R. I. . . Apr. 26, 1900.
Charles E. Riley . . . Textile Machinery, C. E. Riley & Co. . . . . 281 Congress St., Box 2815, Boston, Mass. . . . Apr. 25, 1888.
William H. Ritter . . . Gen. Supt. and Purchasing Agt. Johnson & Johnson . . . . . 266 George St., New Brunswick, N. J. Apr. 26, 1900.
George W. Robbins . . Supt. Dyerville Mfg. Co., ... 610 Manton Ave., Providence, R. I. . . Apr. 28, 1897.

Benj. H. Roberts	General Mill Supplies	163 Grove St., Fall River, Mass.	Apr. 26, 1900.
Charles D. Robinson	Supt. Crompton Co.	Crompton, R. I.	Sept. 27, 1894.
Edwin A. Robinson	Asst. Supt. Tremont and Suffolk Mills	Lowell, Mass.	Oct. 18, 1900.
William A. Robinson	Manville Co.	Woonsocket, R. I.	Apr. 29, 1896.
W. H. Rose	Sec'y & Treas. Granby Cotton Mills,	Columbia, S. C.	Oct. 18, 1900.
John R. Rostron	Lancaster Mills	Clinton, Mass.	Sept. 29, 1898.
John K. Russell		3003 York St., Philadelphia, Pa.	Apr. 29, 1891.
Edward H. Sanborn	Vice Pres. Cold Spring Bleaching and Finishing Works	Real Estate Trust Bldg., Philadelphia, Pa.	Oct. 18, 1900.
Arnold B. Sanford	Pres. and Mgr. American Cotton Yarn Exchange	67 Chauncy St., Boston, Mass.	Oct. 25, 1882.
J. Herbert Sawyer		93 Federal St., Boston, Mass.	July 19, 1865.
F. C. Sayles	Pres. Baltic Mills Co.	204 Banigan Bldg., Providence, R. I.	Oct. 27, 1897.
George H. Sayward		Winchester, Mass.	Oct. 29, 1890.
Arnold Schaer	Agt. Warren Manufg. Co.	Warren, R. I.	Apr. 24, 1895.
Theodore C. Search	Pres. Cold Spring Bleaching and Finishing Works	32 South Broad St., Philadelphia, Pa.	Oct. 18, 1900.
Charles M. Sears	Supt. West Point Mfg. Co.	Langdale, Ala.	Apr. 28, 1898.
George H. Shapley	Treas. Silver Lake Co., 78 Chauncy St.	Boston, Mass.	Apr. 29, 1896
Frank P. Sheldon	Mill Engineer and Architect	Industrial Trust Bldg. Providence, R. I.	Apr. 25, 1894.
Thomas C. Sheldon	Agt. Fitchburg Duck Mills	8 School St., Fitchburg, Mass.	Oct. 29, 1884.
Willis S. Shepard	Pres. American Net and Twine Co.	Canton, Mass.	Apr. 29, 1896.
William F. Sherman	Mill Engineer	107 New Brazer Bldg., 27 State St., Boston, Mass.	Apr. 15, 1874.
Charles M. Shove	Treas. Granite Mills	Box 45, Fall River, Mass.	Oct. 27, 1875.
Herbert H. Shumway	Treas. and Agt. Corr Manufg. Co.	Taunton, Mass.	Apr. 26, 1893.
Francis H. Silsbee	Supt. Cotton Dept. Pacific Mills	Lawrence, Mass.	Apr. 27, 1887.
Nathaniel G. Simonds	Treas. Naumkeag Steam Cotton Co.,	Salem, Mass.	Apr. 28, 1898.
Louis Simpson		Victoria Chambers, Ottawa, Ont.	Apr. 24, 1895.
Abbott E. Slade	Treas. Laurel Lake Mills	863 High St., Fall River, Mass.	Oct. 25, 1893.
Arthur T. Smith	Supt. Langley Manufg Co. Supt. Aiken Manufg. Co.	Langley, S. C.	Oct. 24, 1895.
Joel Smith	Supt. The J. P. King Manufg. Co.	Augusta, Ga.	Oct. 24, 1895.
J. C. Smith	Supt. Chace Mills	Fall River, Mass.	Oct. 27, 1897.
James Herbert Smith	Supt. Quinebaug Co.	Danielson, Conn.	Apr. 28, 1898.
Thomas Henry Smith	Jamestown Cotton Mill	Jamestown, N. Y.	Apr. 26, 1900.
Ellison A. Smyth	Pres. Pelzer Manufg. Co.	Pelzer, S. C.	Oct. 26, 1892.
William S. Southworth	Agt. Mass. Cotton Mills	Box 1230, Lowell, Mass.	Oct. 31, 1888.
S. S. Spencer	Supt. Conestogo Steam Mills	Lancaster, Pa.	Oct. 25, 1876.
Wilton H. Spencer	Textile Manuf.,	7 Exchange Pl., Providence, R. I.	Apr. 28, 1898.

George E. Spofford . . Supt. Blackstone Mfg. Co. . . . . Blackstone, Mass. . . Apr. 29, 1896.
Henry B. Sprague . . . . . P. O. Box 5077, Boston, Mass. . . . Oct. 5, 1899.
Leroy Springs . . . Pres. Lancaster Cotton Mills . . . Lancaster, S. C. . . Oct. 24, 1895.
George R. Stearns . . Pres. Riverside Mills . . . . . Augusta, Ga. . . . . Apr. 30, 1890.
T. B. Stevenson . . . . Supt. Readville Cotton Mill . . . . Hyde Park, Mass. . . Apr. 26, 1900.
Robert Stewart . . . . Supt. Ashton Mills . . . . . Ashton, R. I. . . . . Apr. 27, 1899.
Walter F. Stiles . . . Treas. Orswell Mills . . . . . Fitchburg, Mass. . . Oct. 24, 1895.
O. W. Stites . . . . . Mgr. Commonwealth Cotton Mfg. Co. Durham, N. C. . . . Oct. 24, 1895.
B. L. Stowe . . . . . Vice-Pres. and Factory Mgr. Eureka Fire Hose Co. . . .
. . . . . Wilkinson and Arlington Aves., Jersey City, N. J. . . Sept. 26, 1901.
Herman F. Straw . . . Agt. Amoskeag Manufg. Co. . . . Manchester, N. H. . Oct. 28, 1885.
John Sullivan . . . . Supt. Union Cotton Mfg. Co. . . . Fall River, Mass. . . Apr. 27, 1899.
Timothy Sullivan . . . Supt. Davol Mills . . . . . Fall River, Mass. . . Apr. 27, 1899.
Walter H. Summersby . Agt. Atlantic Cotton Mills . . . . Lawrence, Mass. . . Oct. 25, 1893.
D. G. Sunderland . . . Treas. The Pelham Mills . . . . . Pelham, S. C. . . . . Oct. 18, 1900.
James O. Sweet . . . . Agt. and Treas. Ashland Cotton Co. Jewett City, Conn. . Apr. 28, 1886.

Robert Rennie Taft . . . . . P. O. Box 1443, Providence, R. I. . . Apr. 24, 1895.
Robert W. Taft . . . . Treas. Coventry Co. . . Box 1144, Providence, R. I. . . Sept. 27, 1894.
George P. Taylor . . . Treas. Danielsonville Cotton Co. of Danielson, Conn. . . .
. . . . . Clinton, Mass. . . . Oct. 27, 1880.
James W. Taylor . . . Agt. Canoe River Mills . . Box 46, Taunton, Mass. . . . Oct. 26, 1892.
W. Marshall Taylor . . . . . 34 Arlington St., Holyoke, Mass. . . . Sept. 22, 1896.
Richard Thackeray . . Supt. Weetamoe Mills . . . . . Fall River, Mass. . . Apr. 29, 1885.
S. Willard Thayer . . . Treas. Dexter Yarn Co. . . . . Pawtucket, R. I. . . Sept. 26, 1901.
Earl A. Thissell . . . . Gen. Mgr. Woonsocket Bobbin Co. Woonsocket, R. I. . . Oct. 30, 1878.
Ariel C. Thomas . . . Agt. Saratoga Victory Mfg. Co. . . . . .
. . . . . Victory Mills, Saratoga Co., N. Y. . . Oct. 31, 1888.
Charles E. Thomas . . Treas. Forestdale Manufg. Co. . . . . .
. . . . . 44 Prospect St., Woonsocket, R. I. . . Oct. 31, 1883.
Edward W. Thomas . . Gen. Mgr. Erwin, Pearl, Durham, ...
. . . . . Alpine and Cooleemee Cotton Mills, West Durham, N. C. . Apr. 30, 1884.
Ralph E. Thomson . . Supt. Parkhill Manufg. Co., Mill C. Fitchburg, Mass. . . Apr. 25, 1894.
D. M. Thompson . . . Gen. Mgr. B. B. and R. Knight's Mills . . . . . .
. . . . . Box 1442, Providence, R. I. . . Oct. 28, 1885.
James O. Thompson, Jr. Supt. Wamsutta Mills . . . . . New Bedford, Mass. . Oct. 18, 1900.
Joseph S. Tidd . . . . Treas. and Agt. Oakland Mills . . . Taunton, Mass. . . . Apr. 27, 1899.
Horace W. Tinkham . Treas. and Agt. Robeson Mills . . . Fall River, Mass. . . Apr. 27, 1899.
W. O. Todd . . . . . Sec. and Treas. Lawton Spinning Co. Box 1125, ...
. . . . . 621 Banigan Building, Providence, R. I. . . Oct. 18, 1900.
James P. Tolman . . . Pres. Samson Cordage Works . . . . . .
. . . . . 115 Congress St., Boston, Mass. . . . Oct. 29, 1890.
D. A. Tompkins . . . Pres. Atherton Cotton Mill . . . . Charlotte, N. C. . . . Oct. 24, 1895.
George W. Towne . . . Mgr. Columbus Power Co. . . . . Columbus, Ga. . . . Oct. 26, 1892.
Edward B. Townsend, . Treas. Warwick Mills, ...
. . . . . 53 State St., Room 632, Boston, Mass. . . . Apr. 25, 1901.

Robert B. Treat	Prop. Centerville Cotton Mills	Centerville, R. I.	Sept. 27, 1894.
C. H. Truesdell	Supt. Attawaugan Mill & Ballou Mill, Killingly, Conn.		Oct. 29, 1884.
Edmund E. Truesdell	Supt. China, Webster & Pembroke Mills	Suncook, N. H.	Apr. 26, 1876.
Oscar B. Truesdell	18 Washington Terrace	Newtonville, Mass.	Oct. 15, 1873.
George E. Tucker	Agt. Otis Co.	Ware, Mass.	Oct. 24, 1895.
Philip S. Tuley	Pres. and Treas. Louisville Cotton Mills Co.	1008 Goss Ave., Louisville, Ky.	Oct. 18, 1900.
Charles D. Turnbull	Treas. Wm. A. Slater Mills Corp.	P. O. Box 5324, 89 State St., Boston Mass.	Oct. 27, 1897.
George W. Turner	Supt. Argo Mills Co.	Gloucester, N. J.	Apr. 26, 1900.
William D. Twiss	Supt. Everett Mills	Lawrence, Mass.	April 29, 1896.
Charles T. Upton	63 Mt. Vernon St.,	Lowell, Mass.	Apr. 28, 1897.
George A. Vaughan	Supt. The Putnam Manufg. Co.	Putnam, Conn.	Sept. 22, 1896.
William P. Vaughan	Agt. Putnam Manufacturing Co.	Banigan Building, Providence, R. I.	Sept. 29, 1898.
Eugene F. Verdery	Pres. and Treas. Warren Mfg. Co.	Augusta, Ga.	Apr. 26, 1900.
James P. Verdery	Pres. Enterprise Mfg. Co.	Augusta, Ga.	Apr. 26, 1900.
Frank P. Vogl	Agt. Monadnock Mills	Claremont, N. H.	Sept. 27, 1894.
Jude C. Wadleigh	Supt. Mass. Cotton Mills	Lowell, Mass.	Oct. 26, 1892.
Herbert E. Walmsley	Agt. Wamsutta Mills	New Bedford, Mass.	Oct. 29, 1890.
Robinson Walmsley	Supt. Tecumseh Mills,	P. O. Box 246, Fall River, Mass.	Apr. 27, 1899.
Frederick T. Walsh	Mgr. Thomas Leyland & Co., Dyestuffs, etc.	53 India St., Boston, Mass.	Apr. 28, 1897.
James A. Walsh	Agt. Lewiston Bleachery and Dye Works	Lewiston, Me.	Apr. 27, 1892.
Joseph Watters	Supt. Osborn Mills	Fall River, Mass.	Apr. 26, 1900.
F. E. Wattles	Agt. Boscawen Mills	Penacook, N. H.	Oct. 5, 1899.
Joseph W. Wattles	Manufacturers' Supplies	Canton Junction, Mass.	July 18, 1866.
George W. Weeks		Clinton, Mass.	Apr. 21, 1869.
W. B. Smith Whaley	Mechanical & Mill Engineer Pres. Richland Cotton Mills Granby Cotton Mills,	1328 Main St., Columbia, S. C.	Apr. 24, 1895.
H. D. Wheat	Pres. and Treas. Gaffney Mfg. Co. Pres. and Treas. Alpha Mills, Charlotte, N. C.	Gaffney, S. C.	Apr. 24, 1895.
Channing Whitaker	Infringement and Patentability of Inventions	Lowell Machine Shop, Lowell, Mass.	Oct. 15, 1873.
A. Tenny White	Supt. Manville Co.	Manville, R. I.	Oct. 26, 1887.
Charles D. White	Agt. Uncasville Mfg. Co.	Norwich, Conn.	Oct. 27, 1897.
Arthur F. Whitin	Pres. Saunders Cotton Mills	Whitinsville, Mass.	Apr. 24, 1895.
Fred B. Whitin	Agt. Uxbridge Cotton Mills	Linwood, Mass.	Apr. 28, 1897.
Henry T. Whitin	Treas Paul Whitin Manufg. Co.	Northbridge, Mass.	Apr. 25, 1877.

Alfred N. Whiting . . Sec. and Treas. L. M. Harris Manufg. Co. . . . . 167 Pleasant St., Worcester, Mass. . . Apr. 21, 1875.
William Whitman . . Treas. Arlington Mills, ... P. O. Box 3590, ... 78 Chauncy St., Boston, Mass. . . . . Apr. 25, 1901.
William S. Whitney . . Supervising Engineer, American Woolen Co. . . . . Lawrence, Mass. . . Apr. 24, 1878.
Arthur Whittam . . . Director Textile Dept., Mississippi Agricultural and Mechanical College, ... Agricultural College, Miss., Apr. 28, 1898.
William Whittam, Jr. . . . . P. O. Box 352, Knoxville, Tenn. . . Apr. 26, 1893.
George F. Whitten . . Agt. Amory Mfg. Co. . . . . Manchester, N. H. . Oct. 26, 1892.
John H. Whitten . . . . . Manchester, N. H. . Apr. 28, 1898.
W. R. B. Whittier . . Mgr. Whittier Mills . . . Chattahoochee, Fulton Co., Ga. . Oct. 18, 1900.
Nelson Whittier . . . Treas. Whittier Mills . . . . . Springfield, Mass. . . Oct. 18, 1900.
Edward B. Wilbur . . Gen. Mgr. Mollohon Mfg. Co. . . . Newbury, S. C. . . . Oct. 30, 1889.
Benjamin Wilcox . . . Treas. City and Bristol Mfg. Co. . . New Bedford, Mass. . Apr. 26, 1900.
Henry M. Wilcox . . . Treas. John Rhodes Warp Co. . . . Millbury, Mass. . . . Apr. 24, 1889.
John B. Wild . . . . Pres. Oneita Knitting Mills . . . . Utica, N. Y. . . . . Apr. 26, 1900.
Eben C. Willey . . . . . Lawrence, Mass. . . Apr. 29, 1896.
Franklin D. Williams . Treas. Fiskdale Mills, ... 87 Milk St., Room 21, Boston, Mass. . . . . Apr. 25, 1901.
Broadus E. Willingham, Sec. and Treas. Willingham Cotton Mills . . . . . Macon, Ga. . . . . Oct. 18, 1900.
Theop. W. Wilmarth . Supt. Lynchburg Cotton Mill Co. . . . . 1205 Floyd St., Lynchburg, Va. . . . Oct. 31, 1883.
Thomas Wilmarth . . . Supt. Saunders Cotton Mills . . . . Saundersville, Mass. . Apr. 21, 1875.
George Wood . . . . Pres. and Treas. Millville Manufg. Co. . . . . 626 Chestnut St., Phila., Pa. . . . . Oct. 16, 1872.
John P. Wood . . . . . Spring Garden and 22d Sts., Philadelphia, Pa. . . Apr. 28, 1897.
Oscar W. Wood . . . Treas. Germantown Spinning Co. . . . . Germantown, Philadelphia, Pa. . . Oct. 18, 1900.
C. J. H. Woodbury . . Secretary and Treasurer . . . . . Lynn, Mass. . . . . Oct. 29, 1879.

Adelbert R. Young . . Supt. Ashland Cotton Co. . . . . Jewett City, Conn. . . Apr. 25, 1894.
James M. Young . . . Mgr. Hamilton Cotton Co. . . . . Hamilton, Ont., Can. Apr. 27, 1899.

ASSOCIATE MEMBERS.

S. B. Alexander, Jr. . . Pres. S. B. Alexander, Jr. Co. . . . Charlotte, N. C. . . . Oct. 18, 1900.
Eugene C. Andres . . Cotton Merchant . . . . . 577 John Hancock Building, Boston, Mass. . . . . Oct. 18, 1900.
Henry B. Ashton . . . Agt. S. A. Felton & Son Co. . . . . 153 Adams St., Medford, Mass. . . . Apr. 26, 1900.
Henry Ashworth . . . Agt. of Elijah Ashworth, Mfr. of Card Clothing . . . . . Box 427, Fall River, Mass. . . Apr. 28, 1897.

George R. Babbitt . . . Pres. and Gen. Mgr. American Oil Co. . . . . 182 So. Water St., Providence, R. I. . . . Apr. 24, 1895.
D. C. Ball . . . . . Gen. Mgr. The American Cotton Co. . . . . 25 Broad St., New York, N. Y. . . . Oct. 24, 1895.
Edwin Barnes . . . . Vice Pres. Wm. Firth Co. . . . . 67 Equitable Building, Boston, Mass. . . . . Apr. 26, 1900.
George S. Barnum . . Sec. and Treas. The Bigelow Co. . New Haven, Conn. . Apr. 24, 1895.
Colin C. Bell . . . . Pres. and Treas. Laminar Fibre Co. No. Cambridge, Mass. Apr. 29, 1896.
Frank P. Bennett . . . Publisher American Wool and Cotton Reporter . . . . . 530 Atlantic Ave., Boston, Mass. . . . Sept. 22, 1896.
William H. Bent . . . Treas. Mason Machine Works . . . Taunton, Mass. . . . April 29, 1896.
F. H. Bishop . . . . . Gen. Mgr. Universal Winding Co. . . . . 95 South St., Boston, Mass. . . . . Apr. 26, 1900.
Arthur T. Bradlee, . . Mgr. Cotton Yarn Dept., Harding, Whitman & Co. . . . . 78 Chauncy St., Boston, Mass. . . . . Apr. 25, 1901.
J. Payson Bradley . . . The Kehew Bradley Co. . . . . 24 Purchase St., Boston, Mass. . . . Apr. 24, 1895.
J. Frank Braids . . Mgr. Grease & Oil Dept., Charles S. Bush Co. . . . . 212 Weybosset St., Providence, R. I. . . Apr. 28, 1897.
Henry G. Brinckerhoff . N. E. Mgr. Green Fuel Economizer Co., Box 2654 . . . . Room 1053, Exchange Bldg., 53 State St., Boston, Mass. Sept. 22, 1896.
D. Russell Brown . . . Pres. Brown Bros. Co. . . . . 62 Exchange Place, Providence, R. I. . . Apr. 24, 1895.
H. Martin Brown . . . Treas. U. S. Bobbin & Shuttle Co. . Providence, R. I. . . Apr. 24, 1895.
Percy H. Brundage . . . . . 49 Wall St., New York, N. Y. . . Oct. 5, 1899.
John H. Burghardt . . Page Belting Co. . . . 31 Pearl St., Boston, Mass. . . . Apr. 24, 1895.
Eugene E. Burnham . . Belt Mfr. . . . . 252 Lowell St., Lawrence, Mass. . . Oct. 24, 1895.
Fred N. Bushnell . . . Mech. Supt. Narragansett Electric Light Co. . . . . 3 South St., Providence, R. I. . . Sept. 29, 1898.
Harry W. Butterworth . Sec. H. W. Butterworth & Sons . . . . . York and Cedar Sts., Philadelphia, Pa. . . Oct. 27, 1897.
James Butterworth . Pres. H. W. Butterworth & Sons Co. . . . . York and Cedar Sts., Philadelphia, Pa. . . Apr. 24, 1895.

Albert L. Calder, 2nd . Cotton Broker . . . . . 28 Market Square, Box 206, Providence, R. I. . . Apr. 26, 1900.
French Campbell . . . Commission Merchant, 75 Granite St., Manchester, N. H. . Oct. 27, 1897.
Malcolm Campbell . . Gen. Mgr. Woonsocket Machine and Press Co. . . . . Woonsocket, R. I. . . Apr. 24, 1895.
W. W. Carey . . . . . Mfr. Wood Rim Pulleys and Wood Working Machinery . . . . . 514 Broadway, Lowell, Mass. . . . . Apr. 24, 1895.
Albert C. Case . . . . Pres. American Cotton Co. . . . . 25 Broad St., New York, N. Y. . . Sept. 26, 1901.
J. E. Cheesman . . . . Gen. Mgr. Cheesman Cotton Gin Co. . . . . 27 William St., New York, N. Y. . . Oct. 5, 1899.

Charles H. Child . . . Treas. Standard Mill Supply Co. . . . . P. O. Box 1406, 77 Exchange Place, Providence, R. I. . . . Apr. 24, 1895.
Henry C. Clark . . . . Pres. Charlotte Supply Co. . . . . Charlotte, N. C. . . . Apr. 28, 1898.
C. C. Cowan . . . . . 372 Front St., Memphis, Tenn. . . Oct. 5, 1899.
Thomas G. Cox . . . . Selling Agt. Mason Machine Works . . . . . Box 316, . Taunton, Mass. . . . Apr. 24, 1895.
George Crompton . . . . . Worcester, Mass. . . Oct. 27, 1897.
Randolph Crompton . . . . . Worcester, Mass. . . Oct. 27, 1897.
C. F. Curwen . . . . Treas. Dinsmore Mfg. Co. . . . . Salem, Mass. . . . . Apr. 27, 1899.
Joseph L. Cushing . . Mfr. of Cotton Conveying Systems, Daniel Cushing & Co., ... Box 885, Lowell, Mass. . . . . Apr. 26, 1900.

Frederick I. Dana . . . Manager. Thomas Phillips Co. . . . Providence, R. I. . . Apr. 24, 1895.
E. W. Davenport . . . Supt. Crompton & Knowles Loom Works . . . . . Providence, R. I. . . Sept. 26, 1901.
John O. DeWolf, . . . Mech. Engineer, 1012 Tremont Bldg., Boston, Mass. . . . Apr. 25, 1901.
C. E. W. Dow . . . . So. Agt. American Moistening Co. & Wm. Firth Co. . . . . 40 So. Forsyth St., Box 410, Atlanta, Ga. . . . Apr. 24, 1895.
Frederick A. Downes . Sec. Factory Mutual Fire Insurance Cos. . . . . 925 Chestnut St., Philadelphia, Pa. . . Oct. 27, 1897.
W. L. Draper . . . . Mgr. Dodge Mfg. Co. . . . . Atlanta Branch, 522 Prudential Building, Atlanta, Ga. . . . Oct. 18, 1900.

Fred W. Easton, . . . Treas. Easton & Burnham Machine Co., ... 180 Weeden St., Pawtucket, R. I. . . Apr. 25, 1901.
G. B. Emmons . . . . Pres. Emmons Loom Harness Co. . . . . May St., Lawrence, Mass. . . Oct. 24, 1895.
T. C. Entwistle . . . . Cotton Machinery Builder . . . . . 297 Market St., Lowell, Mass. . . . . Apr. 24, 1895.

D. D. Felton . . . . . Treas. S. A. Felton & Son Co. . . . Manchester, N. H. . Apr. 24, 1895.
John W. Ferguson . . Contractor . . . . . Paterson Nat. Bank Bldg., Paterson, N. J. . . . Apr. 24, 1895.
Redington Fiske . . . Gen. Mgr. Planters Compress Co. . . . . 183 Essex St., Boston, Mass. . . . Apr. 27, 1899.
J. Herbert Foster . . . Cotton Broker . 10 South Water St., Providence, R. I. . . Apr. 24, 1895.
Merrill A. Furbush . . . . . 2015 North 33rd St., Philadelphia, Pa. . . Oct. 27, 1897.
John T. Fyans . . . . Agt. Fyans, Frazer & Blackway Co. . . . . 411 Beach St., Fall River, Mass. . . Apr. 28, 1897.

H. P. Garland . . . . Treas. Loom Picker Co. . . . . Biddeford, Me. . . . Oct. 24, 1895.
Royal W. Gates . . . . Josiah Gates & Sons, Belting . . . . . 307 Market St., Lowell, Mass. . . . Apr. 24, 1895.
Rufus B. Goff . . . . Pres. Standard Mill Supply Co. . . . . 77 Exchange Pl., Box 714, Providence, R. I. . . Apr. 28, 1897.

Sumner S. Gould . . . Mgr. Lowell Branch American Card Clothing Co. . . . .
. . . . . Lowell, Mass. . . . Oct. 5, 1899.
William S. Granger . . Prest. Granger Foundry & Machine Co., Providence, R. I. . Apr. 24, 1895.
Henry T. Grant, Jr. . . Pres. Mercantile Mutual Fire Ins. Co. . . . . .
. . . . . Box 1153, 723 Banigan Building, Providence, R. I. . . Oct. 27, 1897.
Arthur F. Gray . . . . Mill Architect and Engineer . . . . . .
. . . . . 53 State St., Room 509, Boston, Mass. . . . Oct. 18, 1900.

A. Walter Harris . . . Treas. A. W. Harris Oil Co. . . . . .
. . . . . 326 So. Water St., Providence, R. I. . . Oct. 24, 1895.
Alfred H. Hartley . . Dealer in Oils and Mill Supplies . . . . . .
. . . . . Box 409, Fall River, Mass. . . Oct. 27, 1897.
Jerome Hill . . . . . Pres. Tennessee Planters' Co. . . . . .
. . . . . 334 Front St., Memphis, Tenn. . . . Apr. 29, 1896.
Richard H. Hill . . . Gen. Sales Agt. James Hunter Machine Co. . . . . .
. . . . . 70 Kilby St., Boston, Mass. . . . . Apr. 26, 1900.
Alfred K. Hobbs . . . Rubber, Leather and Mill Supplies . Manchester, N. H. . Oct. 18, 1900.
John Hogg . . . . . Smith, Hogg & Gardiner, 144 Essex St., Boston, Mass. . . . Apr. 27, 1899.
Henry A. Holcomb . . . . . Box 249, New Bedford, Mass. . Oct. 24, 1895.
Henry S. Houghton, Sr., Mfr. Grids and Beaters, 61 Pond St., Woonsocket, R. I. . Apr. 28, 1897.
Lewis T. Houghton . . Mfr. Thread Guides . 997 Main St., Worcester, Mass. . . Sept. 26, 1901.
A. H. Howard . . . . Pres., Treas. and Gen. Mgr. Howard Bros. Card Clothing Co.
. . . . . P. O. Box 54, Worcester, Mass. . . Sept. 26, 1901.
Lemuel R. Howe . . . Importer & Dealer in Dye Stuffs, Howe, Fuller & Trunkett,
. . . . . 92 State St., Boston, Mass. . . . Apr. 25, 1901.
C. H. Hutchins . . . . Pres. Crompton & Knowles Loom Works . . . . . .
. . . . . Worcester, Mass. . . Oct. 24, 1895.

David Jackson . . . . Gen. Mgr. Jackson Pat. Shell Roll Co., Pawtucket, R. I. . . Apr. 24, 1895.

Lawrence M. Keeler . Whitin Machine Works . . . . . Whitinsville, Mass. . Sept. 26, 1901.
William B. Kehew . . The Kehew-Bradley Co., ...
. . . . . 24 Purchase St., Boston, Mass. . . . Apr. 24, 1895.
James H. Kendall . . Edward Kendall & Sons . . . . . Cambridgeport, Mass., Sept. 29, 1898.
John E. Kendrick . . . Vice-Pres. American Supply Co. . . . . .
. . . . . Box 822, Providence, R. I. . . Oct. 5, 1899.
Frank B. Kenney . . . Kitson Machine Co. . . . . Lowell, Mass. . . . Oct. 5, 1899.

W. C. Langford . . . Salesman, . . . 86 Weybosset St., Providence, R. I. . . Apr. 27, 1899.
Josiah M. Lasell . . . Asst. Treas. Whitin Machine Works, Whitinsville, Mass. . Apr. 24, 1895.
Samuel D. Lawton . . Treas. Fall River Machine Co. . . . Fall River, Mass. . . Oct. 18, 1900.
John H. Lorimer . . . Builder of Textile Machines . . . . . .
. . . . . Ontario and Lawrence Sts., Philadelphia, Pa. . . Oct. 27, 1897.
Stephen C. Lowe . . . Agt. John Hetherington & Sons, Ltd., New Bedford, Mass. . Oct. 24, 1895.
George A. Lowry . . . Consulting Eng., . 299 Marginal St., East Boston, Mass. . Apr. 28, 1898.

Francis E. Macomber . Mill Supplies . . . . 21 Pearl St., Boston, Mass. . . . . Apr. 26, 1900.
Fay H. Martin . . . . Prop. The Dunn Flyer . . . . . Hyde Park, Mass. . . Sept. 26, 1901.
F. H. Maynard . . . . Bus. Mgr. Gen. Fire Extinguisher Co., Providence, R. I. . . . Apr. 24, 1895.
John McCullough, . . . Cotton Waste Merchant . . . . . New Bedford, Mass. . April 25, 1901.
D. E. McGaw . . . . Mgr. Supply Dept.. Southern Belting Co. . . . . P. O. Box 63, Atlanta, Ga. . . . . Oct. 18, 1900.
H. G. McKerrow . . . Textile Machinery Importer . . . . . 31 State St., Boston, Mass. . . . Sept. 22, 1896.
D. K. McLaren . . . . Mfr. of Leather Belting 751 Craig St., Montreal, P. Q., Can. Apr. 26, 1900.
George H. Meader . . Steam Appliances . . 35 Oliver St., Boston, Mass. . . . Apr. 24, 1895.
John R. Mitchell . . . Mitchell-Bissell Co., 362 Bourse Bldg., Philadelphia, Pa. . . Oct. 18, 1900.
Charles B. Moore . . . Agt. Knowles Steam Pump Works . . . . . 54 Oliver St., Boston, Mass. . . . . Apr. 26, 1900.
George B. Morison . . Catlin & Co. . . . 67 Chauncy St., Boston, Mass. . . . Apr. 24, 1895.

John H. Nelson . . . . Treas. William Firth Co. . . . . 67 Equitable Building, Box. 1460, Boston, Mass. . . . . Apr. 26, 1900.
George C. Newell . . . Starkweather & Shepley . . . . . 17 Custom House St., Providence, R. I. . . Sept. 29, 1898.
William R. Noone . . . . . 102 South St., Boston, Mass. . . . Oct. 27, 1897.

Sidney B. Paine . . . General Electric Co., 200 Summer St., Boston, Mass. . . . Apr. 24, 1895.
Arthur Parkinson . . . Selling Agt. Arabol Mfg. Co. . . . . 13 Gold St., New York, N. Y. . . Apr. 28, 1897.
Stephen Minot Pitman . Sec'y Narragansett Mutual Fire Insurance Co. . . . . 721 Banigan Bldg., Box 315, Providence, R. I. . . Apr. 24, 1895.
Vladimir P. Polevoy . { Agent Great Yaroslavskaia Cotton Mill (of Yaroslave), Russia . . . } 120 Broadway, N. Y. Apr. 28, 1897.
Charles A. M. Praray . Chas. A. M. Praray & Co., Mill Architect and Engineer . . . . . 832 and 833 Banigan Building, Providence, R. I. . . Apr. 28, 1897.

Charles F. Randall . . Expert in Textiles . . . . . Room 350, Tremont Building, Boston, Mass. . . . Apr. 24, 1895.
Peleg A. Rhodes . . . Inspector of Cotton Mills . . . . . P. O. Box 315, Providence, R. I. . . Oct. 5, 1899.
Richard H. Rice . . . Treas. Providence Engineering Works . . . . . 521 So. Main St., Providence, R. I. . . Apr. 24, 1895.
E. R. Richardson . . . Asst. Treas. Howard & Bullough American Machine Co., Ltd. . . . . Box 678, Pawtucket, R. I. . . Apr. 26, 1900.
C. E. Roberts . . . . Mgr. Hartford Steam Boiler Inspection & Insurance Co. . . . . 125 Milk St., Boston, Mass. . . . Apr. 24, 1895.
Louis E. Robinson . . Cotton Agent Sea Island Cotton . . . . . 34 So. Water St., Providence, R. I. . . Oct. 27, 1897.
George I. Rockwood, . Mechanical Engineer, 62 Summer St., Worcester, Mass. . . Apr. 25, 1901.
E. A. Rusden . . . . Treas. Rusden Machine Co. . . . . Warren, R. I. . . . Oct. 18, 1900.
John M. Russell . . . . . Treas. Crompton & Knowles Loom Works . . . . . Worcester, Mass. . . Oct. 24, 1895.

Dwight Seabury . . . Mill Engineer, . . . 12 East Ave., Pawtucket, R. I. . . Apr. 25, 1901.
J. A. Shepherd . . . . N. E. Mgr. The Stirling Co. . . . . .
. . . . . 53 State St., Room 631, Exchange Building, Boston, Mass. . . . Oct. 18, 1900.
Harry M. Smith . . . Vice-Pres. Standard Mill Supply Co. . . . . .
. . . . . 77 Exchange Pl., Box 714, Providence, R. I. . . Apr. 28, 1897.
R. Paul Snelling . . . Treas. Saco and Pettee Machine Shops . . . . . .
. . . . . Newton Upper Falls, Mass. . Sept. 22, 1896.
Henry C. Spence . . . Gen. Mgr. Metallic Drawing Roll Co. Indian Orchard, Mass. Apr. 24, 1895.
George W. Stafford . . . . . P. O. Box 311, Providence, R. I. . . Apr. 24, 1895.
H. E. Stafford . . . . . P. O. Box 311, Providence, R. I. . . Oct. 18, 1900.
James Strang . . . . Selling Agt. Metallic Drawing Roll Co. . . . . .
. . . . . 123 Hampden St., Indian Orchard, Mass. Oct. 27, 1897.
William H. Stratton . . Mgr. Factory Insurance Association . . . . . .
. . . . . 95 Pearl St., Hartford, Conn. . . Apr. 28, 1897.
Daniel J. Sully . . . . Cotton Broker, T. M. Reynolds & Co., ...
. . . . . 34 South Water St., Providence, R. I. . . Apr. 24, 1895.
John Sykes, J. P. . . . Pres. English Card Clothing Co. . . . . .
. . . . . Acre House, Huddersfield, Eng. . Oct. 18, 1900.
Cyrus A. Taft . . . . Agt. Whitin Machine Works . . . Whitinsville, Mass. . Apr. 24, 1895.
Charles F. Taylor . . . Successor to Burgess Cop Tube Co., ...
. . . . . 21 Eddy St., Providence, R. I. . . Apr. 28, 1898.
James T. Thornton . . Vice-Pres. and Treas. A. B. Pitkin Machinery Co. . . . .
. . . . . Providence, R. I. . . Oct. 18, 1900.
William V. Threlfall . . Selling Agt. Saco and Pettee Machine Shops . . . . . .
. . . . . Biddeford, Me. . . . Apr. 24, 1895.
Rienzi W. Thurston . Machinery Manufacturer . . . . . Fall River, Mass. . . Oct. 18, 1900.
H. A. Tillinghast, . . . Sec. and Treas. Granger Foundry & Mach. Co., ...
. . . . . Providence, R. I. . . Apr. 25, 1901.
A. Curtis Tingley . . . Treas. National Ring Traveler Co. . . . . .
. . . . . 257 West Exchange St., Providence, R. I. . . Sept. 22, 1896.
Allison W. Trafford . . Mfr. of Ring Travelers . . . . . .
. . . . . 116 Pocasset St., Fall River, Mass. . . Apr. 26, 1900.

Frank H. Underwood . Resident Mgr. Dodge Mfg. Co. . . . . .
. . . . . 137 Purchase St., Boston, Mass. . . . Apr. 29, 1896.

Clement A. Wakefield . Selling Agt. Saco & Pettee Machine Shops, ...
. . . . . Biddeford, Me. . . . Apr. 25, 1901.
Justin A. Ware . . . . Crompton & Knowles Loom Works . Worcester, Mass. . . Oct. 24, 1895.
Lettice R. Washburn . Mill Contractor, 235 North Water St., New Bedford, Mass. . Oct. 5, 1899.
Walter S. Watson . . . Haworth & Watson, Mfrs. Paper Tubes for Textile Manufg.
. . . . . Box 996, Lowell, Mass. . . . Oct. 24, 1895.
Stephen M. Weld, . . Cotton Buyer . . . . . 89 State St., Boston, Mass. . . . Apr. 27, 1899.
William R. West . . . Roll Coverer . . 830 Purchase St., New Bedford, Mass. . Sept. 22, 1896.

W. W. White	Agent Holyoke Machine Co.	Worcester, Mass.	Apr. 27, 1899.
G. Marston Whitin	Treas. Whitin Machine Works	Whitinsville, Mass.	Apr. 24, 1895.
Fred A. Wilde	Gen. Mgr. The A. T. Atherton Machine Co.	96 Broad St., Pawtucket, R. I.	Apr. 28, 1897.
Erving Yale Woolley	Stoddard, Haserick, Richards & Co.	152 Congress St., Boston, Mass.	Apr. 24, 1895.

Honorary Members	4
Active Members	515
Associate Members	142
Total Membership	661

MEMBERS OF THE ASSOCIATION,

Sept. 26, 1901.

ARRANGED BY STATES.

MAINE.

Auburn	William Hayes	Barker Mill.
Biddeford	H. P. Garland	Loom Picker Co.
Biddeford	Robert McArthur	Pepperell Mfg. Co.
Biddeford	William V. Threlfall	Saco & Pettee Machine Shops.
Biddeford	Clement A. Wakefield	Saco & Pettee Machine Shops.
Brunswick	Russell W. Eaton	Cabot Manufg. Co.
Camden	Frederick K. Allen	Megunticook Woolen Co.
Kennebunk	Robert W. Lord	R. W. Lord & Co.
Lewiston	Joseph P. Battles	Lewiston Mach. Co.
Lewiston	George W. Bean	Androscoggin Mills.
Lewiston	H. B. Estes	Continental Mills.
Lewiston	William D. Pennell	Hill Manufg. Co.
Lewiston	Herbert L. Pratt	Bates Manufg. Co.
Lewiston	James A. Walsh	Lewiston Bleachery and Dye Works
Lisbon	W. H. Miles	Farwell Mills.
Saco	James G. Garland	
Saco	Elmer E. Page	York Manufg. Co.
Sanford	Louis B. Goodall	Goodall Worsted Co.
Westbrook	Philip Dana	Dana Warp Mills.
Westbrook	Woodbury K. Dana	Dana Warp Mills.

NEW HAMPSHIRE.

Charlestown	Samuel Webber	Hydraulic Engineer.
Claremont	Frank P. Vogl	Monadnock Mills.
Dover	Charles H. Fish	Cocheco Manufg. Co.
Dover	George A. Hurd	Cocheco Manufg. Co.

Exeter	Hervey Kent	Exeter Manufg. Co.
Greenville	Frederick W. Ely	Columbian Manufg. Co.
Hooksett	Stephen N. Bourne	Dundee Mills.
Manchester	Henry Deane Bourne	Hooksett Manufg. Co.
Manchester	French Campbell	75 Granite St.
Manchester	George A. Clark	Manchester Mills.
Manchester	D. D. Felton	S. A. Felton & Son Co.
Manchester	Alfred K. Hobbs	Rubber, Leather and Mill Supplies
Manchester	Elliott Cowdin Lambert	Amoskeag Manufg. Co.
Manchester	Charles H. Manning	Amoskeag Manufg. Co.
Manchester	Charles D. McDuffie	Manchester Mills.
Manchester	Herman F. Straw	Amoskeag Manufg. Co.
Manchester	George F. Whitten	Amory Manufg. Co.
Manchester	John H. Whitten	
Milford	M. F. Foster	
Milford	Frank E. Kaley	Morse & Kaley Manufg. Co.
Nashua	William D. Cadwell	Nashua Manufg. Co.
Nashua	William H. Cadwell	Jackson Co.
Nashua	Roscoe S. Milliken	Nashua Mfg. Co.
Penacook	Marcellus Gould	N. H. Spinning Mills.
Penacook	F. E. Wattles	Boscawen Mills.
Peterboro	Albert W. Noone	Jos. Noone's Sons' Co.
Pittsfield	George E. Kent	Exeter Manufg. Co. & Pittsfield Mills
Salmon Falls	O. S. Brown	Salmon Falls Manufg. Co.
Somersworth	Charles H. Plummer	Great Falls Manufg. Co.
Suncook	David L. Jewell	China, Webster & Pembroke Mills.
Suncook	Edmund E. Truesdell	China, Webster & Pembroke Mills.

VERMONT.

North Pownal	Thomas Armstrong	North Pownal Manufg. Co.

MASSACHUSETTS.

Adams	John S. Adams, Jr.	Adams Bros. Manufg. Co.
Adams	James C. Chalmers	Renfrew Mfg. Co.
Adams	Z. D. Hall	Berkshire Cotton Manufg. Co.
Adams	A. B. Mole	Greylock Mill.
Adams	Charles T. Plunkett	Berkshire Cotton Manufg. Co.
Adams	L. B. Renfrew	Renfrew Mfg. Co.
Amesbury	M. W. Quinn	Hamilton Woolen Co.
Andover	John W. Bell	Smith & Dove Manufg. Co.
Belmont	John Kilburn	
Blackstone	George E. Spofford	Blackstone Manufg. Co.
Bondsville	Elmer G. Childs	Boston Duck Co.

Boston	Charles B. Amory	Hamilton Mfg. Co.
Boston	Frederic Amory	Nashua Mfg.Co. and Jackson Mfg.Co.
Boston	Eugene C. Andres	577 John Hancock Building.
Boston	Edward Atkinson	Boston Mfrs. Mut. Fire Ins. Co.
Boston	E. W Atkinson	Stoddard, Haserick, Richards & Co.
Boston	Nathaniel F Ayer	Farwell Bleachery.
Boston	Edwin Barnes	Wm. Firth Co.
Boston	Frank P. Bennett	Am. Wool and Cotton Reporter.
Boston	F. H. Bishop	Universal Winding Co.
Boston	Arthur T. Bradlee	Harding, Whitman & Co.
Boston	J. Payson Bradley	The Kehew-Bradley Co.
Boston	Henry G. Brinckerhoff	Green Fuel Economizer Co.
Boston	John H. Burghardt	Page Belting Co.
Boston	Byron F. Card	Harding, Whitman & Co.
Boston	Alfred Clarke,	23 Central St.
Boston	Frank B. Comins	American Moistening Co.
Boston	Sidney Coolidge	Stark Mills.
Boston	Alphonse S. Covel	Tremont and Suffolk Mills.
Boston	Augustus De Cort	Beacon Mfg. Co.
Boston	P Y DeNormandie	Pepperell Mfg. Co.
Boston	Frederic C. Dumaine	Amory Mfg. Co.
Boston	John O. DeWolf	Mech. Engineer.
Boston	Ambrose Eastman	53 State St., Room 904.
Boston	William Firth	Am. Moist. Co. and Wm. Firth Co.
Boston	Redington Fiske	Planters' Compress Co.
Boston	Alfred M. Goodale	Boston Mfg. Co.
Boston	Arthur F. Gray	53 State St., Room 509.
Boston	Stephen Greene	Lockwood, Greene & Co.
Boston	Richard H. Hill	Jas. Hunter Machine Co.
Boston	Franklin W. Hobbs	Arlington Mills.
Boston	John Hogg	Smith, Hogg & Gardiner.
Boston	Henry S. Howe	Dry Goods Commission.
Boston	Lemuel R. Howe	Howe, Fuller & Trunkett.
Boston	Charles W. Hubbard	Ludlow Mfg. Co.
Boston	William B. Kehew	The Kehew-Bradley Co.
Boston	Evan Arthur Leigh	70 Kilby St.
Boston	William C. Lovering	Whittenton Mfg. Co.
Boston	A. Lawrence Lowell	Lowell School of Design.
Boston	Herbert Lyman	P. O. Box 1717.
Boston	Francis E. Macomber	21 Pearl St.
Boston	Charles T. Main	Dean & Main.
Boston	Fred C. McDuffie	Everett Mills and York Mfg. Co.
Boston	H. G. McKerrow	31 State St.
Boston	George H. Meader	35 Oliver St.
Boston	Charles B. Moore	Knowles Steam Pump Works.
Boston	George B. Morison	Catlin & Co.
Boston	John H. Nelson	Wm. Firth Co.

Boston	William R. Noone	102 South St.
Boston	Sidney B. Paine	General Electric Co.
Boston	Francis J. Parker	Monadnock Mills.
Boston	Benjamin Phipps	4 Winthrop Sq.
Boston	Henry Smith Pritchett, LL.D.	Mass. Institute of Technology.
Boston	Charles F. Randall	350 Tremont Building.
Boston	Charles E. Riley	C. E. Riley & Co.
Boston	C. E. Roberts	Hartford Steam Boiler Insp. & Ins.Co.
Boston	Arnold B. Sanford	American Cotton Yarn Exchange.
Boston	J. Herbert Sawyer	93 Federal St.
Boston	George H. Shapley	Silver Lake Co.
Boston	J. A. Shepherd	The Stirling Co.
Boston	Henry B. Sprague	Box 5077.
Boston	William F. Sherman	27 State St.
Boston	James P. Tolman	Samson Cordage Works.
Boston	Edward B. Townsend	Warwick Mills.
Boston	Charles D. Turnbull	Wm. A. Slater Mills Corp.
Boston	Frank H. Underwood	Dodge Mfg. Co.
Boston	Frederick T. Walsh	Thomas Leyland & Co.
Boston	Stephen M. Weld	89 State St.
Boston	William Whitman	Arlington Mills.
Boston	Franklin D. Williams	Fiskdale Mills.
Boston	Erving Yale Woolley	Stoddard Haserick, Richards & Co.
Cambridgeport	James H. Kendall	Edward Kendall & Sons.
Canton	Willis S. Shepard	Amer. Net & Twine Co.
Canton Junction	Joseph W. Wattles	Manufacturers' Supplies.
Chicopee Falls	Henry A. Bailey	Chicopee Manufg. Co.
Clinton	William G. McLoon	Lancaster Mills.
Clinton	Charles H. Richardson	Lancaster Mills.
Clinton	John R. Rostron	Lancaster Mills.
Clinton	George P. Taylor	Danielsonville Cotton Co.
Clinton	George W. Weeks	
East Boston	George A. Lowry	299 Marginal St.
East Hampton	William B. Fittz	West Boylston Mfg. Co.
Fall River	F. S. Akin	Cornell Mills.
Fall River	Henry Ashworth	Agt. for Card Clothing Manufr.
Fall River	John P. Bodge	Arkwright Mills.
Fall River	Jefferson Borden, Jr.	Fall River Bleachery Co.
Fall River	Nathaniel B. Borden	Barnard Manufg. Co.
Fall River	Richard B. Borden	Richard Borden Mfg. Co.
Fall River	Thomas J. Borden	326 North Main St.
Fall River	Isaac A. Brown	Narragansett Mills.
Fall River	George A. Chace	Bourne Mills.
Fall River	Simeon B. Chase	King Phillip Mills.
Fall River	John A. Collins	American Linen Co.
Fall River	B. D. Davol	Barnard Manufg. Co.
Fall River	Frank H. Dwelly	Tecumseh Mills.

Fall River	David H. Dyer	D. H. Dyer & Son.
Fall River	William Evans	Wampanoag Mills.
Fall River	Charles F. Farrar	22 Coggeshall St.
Fall River	John T. Fyans	Fyans, Frazer & Blackway Co.
Fall River	Arthur M. Hamilton	Hargraves and Parker Mills.
Fall River	John F. Hamlet	P. O. Box 160
Fall River	Alfred H. Hartley	Oils and Mill Supplies.
Fall River	Samuel E. Hathaway	Fall River Iron Works Co.
Fall River	William Hathaway	Barnard Mfg. Co.
Fall River	William B. Hawes	P. O. Box 733.
Fall River	George H. Hills	Davol Mills and Stevens Mfg. Co.
Fall River	William P. Holt	Barnaby Mills.
Fall River	Benjamin B. Kirk	Fall River Iron Works Co.
Fall River	George H. Law	Merchants' Mfg. Co.
Fall River	Samuel D. Lawton	Fall River Machine Co.
Fall River	Leontine Lincoln	Seaconnet Mills.
Fall River	John R. Mason	523 Broadway.
Fall River	Philip A. Mathewson	King Philip Mills.
Fall River	Thomas McAuliffe	Stevens Manufg. Co.
Fall River	J. Edward Osborn	American Linen Co.
Fall River	Herbert W. Owen	Merchants' Mfg. Co.
Fall River	Joseph H. Potter, Jr.	Durfee Mills.
Fall River	Benj. H. Roberts	163 Grove St.
Fall River	Charles M. Shove	Granite Mills.
Fall River	Abbott E. Slade	Laurel Lake Mills.
Fall River	J. C. Smith	Chace Mills.
Fall River	John Sullivan	Union Cotton Manufg. Co.
Fall River	Timothy Sullivan	Davol Mills.
Fall River	Richard Thackeray	Weetamoe Mills.
Fall River	Rienzi W. Thurston	Machinery Manufacturer.
Fall River	Horace W. Tinkham	Robeson Mills.
Fall River	Allison W. Trafford	Mfr. Ring Travelers.
Fall River	Robinson Walmsley	Tecumseh Mills.
Fall River	Joseph Watters	Osborn Mills.
Fisherville	Albert W. Dimick	Fisher Mfg. Co.
Fisherville	Charles W. Fisher	Fisher Mfg. Co.
Fiskdale	John Gregson	Fiskdale Mills.
Fitchburg	George P. Grant, Jr.	Grant Yarn Co.
Fitchburg	W. E. Keach	Grant Yarn Co.
Fitchburg	John Leiper	Fitchburg Worsted Mills.
Fitchburg	Arthur H. Lowe	Parkhill Manufg Co.
Fitchburg	David Lowe	Parkhill Manufg. Co.
Fitchburg	Thomas C. Sheldon	Fitchburg Duck Mills.
Fitchburg	Walter F. Stiles	Orswell Mills.
Fitchburg	Ralph E. Thompson	Parkhill Manufg. Co.
Great Barrington	Jno. H. C. Church	Monument Mills.
Greenfield	James C. Deane	Mass. Tool Co.

Holyoke	Ernest Lovering	Lyman Mills.
Holyoke	W. Marshall Taylor	34 Arlington St.
Hopedale	Eben S. Draper	Draper Co.
Hopedale	George A. Draper	Draper Co.
Hopedale	George Otis Draper	Draper Co.
Hopedale	William F. Draper	Draper Co.
Hopedale	William F. Draper, Jr.	Draper Co.
Housatonic	T. G. Ramsdell	Monument Mills.
Hyde Park	Fay H. Martin	Prop. The Dunn Flyer.
Hyde Park	T. B. Stevenson	Readville Cotton Mill.
Indian Orchard	William C. Godfrey	Indian Orchard Co.
Indian Orchard	Henry C. Spence	Metallic Drawing Roll Co.
Indian Orchard	James Strang	Metallic Drawing Roll Co.
Ipswich	James W. Brown	Box 312.
Lawrence	William A. Barrell	Lawrence Duck Co.
Lawrence	Eugene E. Burnham	252 Lowell St.
Lawrence	G. B. Emmons	Emmons Loom Harness Co.
Lawrence	William D. Hartshorne	Arlington Mills.
Lawrence	James I. Milliken	Everett Mills.
Lawrence	Walter E. Parker	Pacific Mills.
Lawrence	Robert Redford	Box 28.
Lawrence	Francis H. Silsbee	Pacific Mills.
Lawrence	Walter H. Summersby	Atlantic Cotton Mills.
Lawrence	William D. Twiss	Everett Mills.
Lawrence	William S. Whitney	American Woolen Co.
Lawrence	Eben C. Willey	
Leicester	Charles A. Denny	American Card Clothing Co.
Linwood	Amos G. Maddox	Linwood Mill.
Linwood	Fred B. Whitin	Uxbridge Cotton Mills.
Lowell	Franklin Allen	Boott Mills.
Lowell	George E. Ames	Lawrence Manufg. Co.
Lowell	Frank A. Bowen	Appleton Co.
Lowell	Edward N. Burke	Lowell Machine Shop.
Lowell	W. W. Carey	Wood Rim Pulleys and Wood Working Machinery.
Lowell	Clarence N. Childs	Hamilton Mfg. Co.
Lowell	A. G. Cumnock	Appleton Co.
Lowell	Joseph L. Cushing	Daniel Cushing & Co.
Lowell	Albert W. Danforth	Shanghai Cotton Cloth Mills.
Lowell	Albert Deabill	Lowell Hosiery Co.
Lowell	Edward P. Dennis	Lowell Machine Shop.
Lowell	William A. Eastman	Lowell Hosiery Co.
Lowell	T. C. Entwistle	Cotton Machinery Builder.
Lowell	Frederick A. Flather	Lowell Machine Shop.
Lowell	Royal W. Gates	Josiah Gates & Sons.
Lowell	Sumner S. Gould	Lowell Branch Am. Card Clo. Co.
Lowell	William E. Hall	Shaw Stocking Co.

Lowell	Otis L. Humphrey	Cotton Dept. Lowell Textile School.
Lowell	A. W. Hunking,	374 Stevens St.
Lowell	Frank B. Kenney	Kitson Machine Co.
Lowell	Nathaniel B. Kerr	Boott Cotton Mills.
Lowell	Alvin S. Lyon	Bigelow Co.
Lowell	Albert H. Morton	Kitson Machine Co.
Lowell	Oliver H. Moulton	Hamilton Manufg. Co.
Lowell	Franklin Nourse	Lawrence Manufg. Co.
Lowell	John W. Pead	Merrimack Manufg. Co.
Lowell	Haven C. Perham	Kitson Machine Co.
Lowell	M. A. Rawlinson	Tremont & Suffolk Mills.
Lowell	Edwin A. Robinson	Tremont and Suffolk Mills.
Lowell	William S. Southworth	Mass. Cotton Mills.
Lowell	Charles T. Upton	63 Mt. Vernon St.
Lowell	Jude C. Wadleigh	Mass. Cotton Mills.
Lowell	Walter S. Watson	Haworth & Watson.
Lowell	Channing Whitaker	Lowell Machine Shop.
Lynn	C. J. H. Woodbury	61 Commercial St.
Medford	Henry B. Ashton	S. A. Felton & Son Co.
Methuen	Lewis E. Barnes	Pemberton Co. and Methuen Co.
Millbury	Fred W. Moore	Cordis Mills.
Millbury	Henry M. Wilcox	John Rhodes Warp Co.
New Bedford	George A. Ayer	City & Bristol Mfg. Corps.
New Bedford	Christopher P. Brooks	New Bedford Textile School.
New Bedford	Robert Burgess	Grinnell Mfg. Corp.
New Bedford	William W. Crapo	Wamsutta Mills.
New Bedford	Frederick Grinnell	Gen. Fire Extinguisher Co.
New Bedford	Henry A. Holcomb	Box 249.
New Bedford	Thomas Horsfield	95 Bonney St.
New Bedford	Walter H. Langshaw	Dartmouth Manufg. Corp.
New Bedford	Stephen C. Lowe	John Hetherington & Sons, Ltd.
New Bedford	Frederick B. Macy	Soule Mills.
New Bedford	John McCullough	Cotton Waste Merchant.
New Bedford	John Neild	Soule Mills.
New Bedford	Albert R. Pierce	Pierce Mfg. Corporation.
New Bedford	Andrew G. Pierce, Jr.	Pierce Mfg. Corp.
New Bedford	Frederick W. Reynolds	Potomska Mills.
New Bedford	James O. Thompson, Jr.	Wamsutta Mills.
New Bedford	Herbert E. Walmsley	Wamsutta Mills.
New Bedford	Lettice R. Washburn	235 North Water St.
New Bedford	William R. West	830 Purchase St.
New Bedford	Benjamin Wilcox	City and Bristol Mfg. Co.
Newton	Josiah G. Coburn	99 Washington St.
Newtonville	Oscar B. Truesdell	18 Washington Terrace.
Newton Upper Falls	Frank J. Hale	Saco and Pettee Machine Shops.
Newton Upper Falls	R. Paul Snelling	Saco and Pettee Machine Shops.
North Adams	Hervey Burnham	Beaver Mills and Eclipse Mill.

North Adams	Charles W. Dennett	Johnson-Dunbar Mills Co.
North Adams	Henry C. Phillips	Greylock Mills.
North Adams	J. F. Powers	Eagle Mill.
Northbridge	Henry S. Houghton, Jr.	Paul Whitin Manufg. Co.
Northbridge	Henry T. Whitin	Paul Whitin Manufg. Co.
North Cambridge	Colin C. Bell	Laminar Fibre Co.
North Oxford	Edwin N. Bartlett	Sigourney and Rockdale Mills.
North Plymouth	Gideon F. Holmes	Plymouth Cordage Co.
Salem	C. F. Curwen	Dinsmore Mfg. Co.
Salem	William P. McMullen	Naumkeag Steam Cotton Co.
Salem	Henry Osgood	P. O. Box 204.
Salem	Nathaniel G. Simonds	Naumkeag Steam Cotton Co.
Saundersville	Thomas Wilmarth	Saunders Cotton Mills.
Shattuckville	Frank S. Field	Massaemit Yarn Mills.
South Hadley Falls	William R. Hill	Glasgow Manufg. Co.
Springfield	Joseph M. Dunham	43 Edwards St.
Springfield	Nelson Whittier	Whittier Mills.
Taunton	A. C. Bent	Safety Seamless Pocket Co.
Taunton	William H. Bent	Mason Machine Works.
Taunton	John J. Connell	Cohannet Mills.
Taunton	Peter H. Corr	Greenwich Bleachery.
Taunton	Thomas G. Cox	Mason Machine Works.
Taunton	P. T. Creed	Hopewell Mills.
Taunton	H. H. Culver	Elizabeth Poole Mills.
Taunton	Henry S. Culver	Westville Cotton Mills.
Taunton	Herbert Fisher	
Taunton	Henry M. Lovering	Whittenton Manufg. Co.
Taunton	William M. Lovering	Whittenton Manufg. Co.
Taunton	Charles L. Macomber	Winthrop Cotton Yarn Co.
Taunton	John Tempest Meats	Mason Machine Works.
Taunton	Herbert H. Shumway	Corr Manufg. Co.
Taunton	James W. Taylor	Canoe River Mills.
Taunton	Joseph S. Tidd	Oakland Mills.
Thorndike	Charles H. Hobbs	Thorndike Co.
Three Rivers	Roscius C. Newell	Palmer Mill.
Turners Falls	Samuel L. Parker	Turners Falls Cotton Mills.
Walnut Hill	Benjamin M. Earle	Merchants Dye Works.
Waltham	Charles E. Getchell	Waltham Bleachery & Dye Works.
Waltham	Arthur H. Gulliver	Boston Mfg. Co.
Ware	George E. Tucker	The Otis Co.
Webster	E. P. Morton	Stevens Linen Works.
West Acton	Henry D. Martin.	
West Warren	George A. Moody	West Warren Cotton Mills.
Whitinsville	Alfred E. Adams	Whitinsville Cotton Mills and Linwood Mills.
Whitinsville	Lawrence M. Keeler	Whitin Machine Works.
Whitinsville	Josiah M. Lasell	Whitin Machine Works.

Whitinsville	Oscar L. Owen	Whitin Machine Works.
Whitinsville	Cyrus A. Taft	Whitin Machine Works.
Whitinsville	Arthur F. Whitin	Saunders Cotton Mills.
Whitinsville	G. Marston Whitin	Whitin Machine Works.
Williamstown Sta.	Roland R. Kelly	Williamstown Manufg. Co.
Winchester	George H. Sayward	
Worcester	George Crompton	
Worcester	Randolph Crompton	
Worcester	Henry F. Harris	W. Boylston Mfg. Co.
Worcester	Lewis T. Houghton	997 Main St.
Worcester	A. H. Howard	Howard Bros. Card Clothing Co.
Worcester	C. H. Hutchins	Crompton & Knowles Loom Works.
Worcester	F. H. Rice	340 Main St.
Worcester	Geo. I. Rockwood	62 Summer St.
Worcester	John M. Russell	Crompton & Knowles Loom Works.
Worcester	Justin A. Ware	Crompton & Knowles Loom Works.
Worcester	W. W. White	Holyoke Machine Co.
Worcester	Alfred N. Whiting	L. M. Harris Mfg. Co.

RHODE ISLAND.

Albion	Andrew J. Currier	Valley Falls Co.
Allenton	R. A. Gray	Rodman Manufg. Co.
Ashton	Charles H. Collins	Berkeley Co.
Ashton	Robert Stewart	Ashton Mills.
Bayside	Abel T. Atherton	Machine Maker.
Central Falls	Louis B. Barker	United States Cotton Co.
Central Falls	David Grove	United States Cotton Co.
Central Falls,	B. F. G. Linnell,	Yarns, Threads and Twines.
Centreville	James T. Ferguson	Warwick Mills.
Centreville	Robert B. Treat	Centreville Cotton Mills.
Crompton	Charles D. Robinson	Crompton Co.
Davisville	Walter B. Knight	Reynolds Manufg. Co.
Fiskville	James Gee	Interlaken Dye Works.
Georgiaville	Herbert R. Farnum	Bernon Mills.
Hamilton	Joseph Warren Greene	Hamilton Web Co.
Lonsdale	Edward A. Mongeon	Lonsdale Co.'s Mills.
Manville	A. Tenny White	Manville Co.
Natick	Charles M. Holmes	Natick Mills.
Pawtucket	William W. Blades	Lorraine Mfg. Co.
Pawtucket	William P. Dempsey	Dempsey Bleachery & Dye Works.
Pawtucket	Henry C. Dexter	Greene & Daniels Mfg. Co.
Pawtucket	Fred W. Easton	Easton & Burnham Machine Co.
Pawtucket	William H. Greene	Greene & Daniels Mfg. Co.
Pawtucket	John J. Hart	Charlton Manufg. Co.
Pawtucket	David Jackson	Jackson Pat. Shell Roll Co.

Pawtucket	J. E. Jenckes	The E. Jenckes Manufg. Co.
Pawtucket	James R. MacColl	Lorraine Manufg. Co.
Pawtucket	E. R. Richardson	Howard & Bullough American Machine Co., Ltd.
Pawtucket	Dwight Seabury	12 East Ave.
Pawtucket	S. Willard Thayer	Dexter Yarn Co.
Pawtucket	Fred A. Wilde	A. T. Atherton Machine Co.
Peace Dale	William C. Greene	Peace Dale Manufg. Co.
Phenix	Henry R. Brown	Hope Co. and Phenix Mill.
Pontiac	Walter B. Hall	Pontiac Mill, B. B. and R. Knight.
Providence	Charles T. Aldrich	Aldrich Manufg. Co.
Providence	William Ames	Fletcher Mfg. Co.
Providence	H. C. Atwood	Williamsville Manufg. Co.
Providence	George R. Babbitt	American Oil Co.
Providence	Edward R. Ballou	Ballou Yarn Converting Co.
Providence	Truman Beckwith	Dyerville Manufg. Co.
Providence	J. Frank Braids	Charles S. Bush Co.
Providence	D. Russell Brown	Brown Bros. Co.
Providence	H. Martin Brown	U. S. Bobbin & Shuttle Co.
Providence	E. C. Bucklin	Interlaken Mills.
Providence	Fred N. Bushnell	Narragansett Electric Light Co.
Providence	Albert L. Calder, 2nd	P. O. Box 206.
Providence	Charles H. Child	Standard Mill Supply Co.
Providence	Frederick I. Dana	Thomas Phillips Co.
Providence	A. Lockwood Danielson	Quinebaug Co.
Providence	J. DeForest Danielson	Lockwood Co. and Lewiston Bleachery and Dye Works.
Providence	John W. Danielson	Lockwood Co. and Ponemah Mills.
Providence	E. W. Davenport	Crompton & Knowles Loom Works.
Providence	F. C. Fletcher	Lawton Spinning Co.
Providence	J. Herbert Foster	10 South Water St.
Providence	William Gammell	Berkeley Co.
Providence	Rufus B. Goff	Standard Mill Supply Co.
Providence	William S. Granger	Granger Foundry & Machine Co.
Providence	Henry T. Grant, Jr.	Mercantile Mutual Fire Insurance Co.
Providence	John H. Hambly	Quidnick Mfg. Co.
Providence	A. Walter Harris	A. W. Harris Oil Co.
Providence	Elisha H. Howard	Harris Textile Co.
Providence	John E. Kendrick	American Supply Co.
Providence	Jesse A. Knight	Lawton Spinning Co.
Providence	Stephen A. Knight	Hebron Manufg. Co.
Providence	Webster Knight	B. B. & R. Knight's Mills.
Providence	W. C. Langford	86 Weybosset St.
Providence	Charles Warren Lippitt	Silver Spring B. & D. Co.
Providence	Henry F. Lippitt	Social and Manville Cos.
Providence	Charles R. Makepeace	Box 973.
Providence	A. T. Malcolmson	C. Bischoff & Co.

Providence	F. H. Maynard	Gen. Fire Extinguisher Co.
Providence	Thomas Mayor	Thomas Mayor & Son.
Providence	Charles H. Merriman, Jr.	Social Mfg. Co.
Providence	George C. Newell	Starkweather & Shepley.
Providence	William C. Peirce	Elizabeth Mills.
Providence	Reuben Pilling, Jr.	30 Hudson St.
Providence	Stephen Minot Pitman	Narragansett Mutual Fire Ins. Co.
Providence	Charles A. M. Praray	Chas. A. M. Praray & Co.
Providence	Peleg A. Rhodes	P. O. Box 315.
Providence	Richard H. Rice	Providence Engineering Works.
Providence	Walter Rigby	Ballou Yarn Converting Co.
Providence	George W. Robbins	Dyerville Mfg. Co.
Providence	Louis E. Robinson	34 So. Water St.
Providence	F. C. Sayles	Baltic Mills Co.
Providence	Frank P. Sheldon	Industrial Trust Building.
Providence	Harry M. Smith	Standard Mill Supply Co.
Providence	Wilton H. Spencer	7 Exchange Place.
Providence	George W. Stafford	P. O. Box 311.
Providence	H. E. Stafford	P. O. Box 311.
Providence	Daniel J. Sully	T. M. Reynolds & Co.
Providence	Robert Rennie Taft	P. O. Box 1443.
Providence	Robert W. Taft	Coventry Co.
Providence	Charles F. Taylor	21 Eddy St.
Providence	D. M. Thompson	B. B. & R. Knight's Mills.
Providence	James T. Thornton	A. B. Pitkin Machinery Co.
Providence	H. A. Tillinghast	Granger Foundry & Machine Co.
Providence	A. Curtis Tingley	National Ring Traveler Co.
Providence	W. O. Todd	Lawton Spinning Co.
Providence	William P. Vaughan	Banigan Building.
Quidnick	Albert Knight	Quidnick Mills.
Riverpoint	Arthur F. Brackett	Royal Arctic and Valley Queen Mills.
Riverpoint	C. Prescott Knight	B. B. & R. Knight's Mills.
Valley Falls	Edward B. Jennings	Samoset Co.
Warren	E. A. Rusden	Rusden Machine Co.
Warren	Arnold Schaer	Warren Manufg. Co.
Westerly	Robert Dow	Solway Mills.
Westerly	A. E. Henry	Solway Mills.
Westerly	Louis L. Hohn	122 High St.
Woonsocket	Malcolm Campbell	Woonsocket Mach. & Press Co.
Woonsocket	William Halliwell	Lawton Spinning Co.
Woonsocket	Henry S. Houghton, Sr.	61 Pond St.
Woonsocket	Albert C. Hoy	Hamlet Mills.
Woonsocket	Albert F. Knight	39 Main Street.
Woonsocket	Robert G. McMeehan	Hamlet Textile Co.
Woonsocket	William A. Robinson	Manville Co.
Woonsocket	Earl A. Thissell	Woonsocket Bobbin Co.
Woonsocket	Charles E. Thomas	Forestdale Mfg. Co.

CONNECTICUT.

Baltic	Harold Lawton	Baltic Mills Co.
Danielson	James Herbert Smith	Quinebaug Co.
Hartford	William H. Stratton	Factory Insurance Association.
Jewett City	James O. Sweet	Ashland Cotton Co.
Jewett City	Adelbert R. Young	Ashland Cotton Co.
Killingly	W. E. Atwood	Williamsville Manufg. Co.
Killingly	C. H. Truesdell	Attawaugan Mill and Ballou Mill.
Montville	Emory S. Rathbun	Pequot Mills.
Moosup	William J. Cray	Aldrich Mfg. Co.
New Haven	George S. Barnum	The Bigelow Co.
No. Grosvenor Dale	Frank M. Messenger	Grosvenor Dale Co.
Norwich	W. N. Blackstone	Attawaugan Co. and Totokett Mills Co.
Norwich	W. R. Burnham	
Norwich	C. H. Frisbie	Attawaugan Co.
Norwich	W. G. Henderson	Shetucket Co.
Norwich	John F. Reardon	Falls Co.
Norwich	Charles D. White	Uncasville Manufg. Co.
Putnam	George W. Holt	Monohansett Manufg. Co.
Putnam	George A. Vaughan	Putnam Manufg. Co.
Taftville	Joseph D. Aiken	Ponemah Mills.
Taftville	John Eccles	Ponemah Mills.
Wauregan	James A. Atwood	Wauregan Co. & Quinebaug Co.
Wauregan	John Walter Atwood	Wauregan Co.
Willimantic	Dickerson G. Baker	American Thread Co.
Willimantic	E. S. Boss	Willimantic Linen Co.
Windsor Locks	J. R. Montgomery	The J. R. Montgomery Co.

NEW YORK.

Capron	W. H. Cloher, Jr.	Utica Cotton Co.
Chadwicks	Bradford C. Divine	Utica Willow Vale Bleaching Co.
Cohoes	David S. Johnston	Cohoes Iron Foundry & Machine Co.
Cohoes	John E. Prest	Harmony Mills.
Jamestown	Thomes Henry Smith	Jamestown Cotton Mill.
Newburgh	William J. Hadfield	Newburgh Steam Mills.
New York City	George Arms	Grand Hotel.
New York City	Edwin H. Baker	Bliss, Fabyan & Co.
New York City	D. C. Ball	American Cotton Co.
New York City	Percy H. Brundage	49 Wall St.
New York City	Albert C. Case	American Cotton Co.
New York City	J. E. Cheesman	Cheesman Cotton Gin Co.
New York City	Arthur B. Mann	J. H. Martin & Co.
New York City	Arthur Parkinson	Arabol Mfg. Co.
New York City	Duncan D. Parmly	Johnson Mfg. Co. & Dunbar Mills Co.

New York City	Vladimir P. Polevoy	120 Broadway.
New York Mills, Oneida Co.,	John P. Campbell,	New York Mills.
Upper Troy	A. G. Harris	W. H. Draper & Son.
Utica	George DeForest	Utica Steam Cotton Mills.
Utica	George E. Farrell	Utica Spinning Co.
Utica	D. W. Gray	Skenandoa Cotton Co.
Utica	Henry F. Mansfield	Utica Steam Cotton Mills and Mohawk Valley Cotton Mills.
Utica	John B. Wild	Oneita Knitting Mills.
Victory Mills	Ariel C. Thomas	Saratoga Victory Mfg. Co.

NEW JERSEY.

Gloucester City	Philip H. Fowler	417 Monmouth St.
Gloucester	George W. Turner	Argo Mills Co.
Jersey City	Ernest Bridge	Jas. Chadwick & Bro. Ltd.
Jersey City	Maxwell Grierson	Jas. Chadwick & Bro., Ltd.
Jersey City	B. L. Stowe	Eureka Fire Hose Co.
Millville	A. W. Brainerd	May's Landing Water Power Co. and Millville Mfg. Co.
Newark	William H. Loftus	Clark Thread Co.
New Brunswick	William H. Ritter	Johnson & Johnson.
Passaic	Dudley T. Lyall	Brighton Mills.
Passaic	William L. Lyall	J. & W. Lyall Loom and Machine Works and Brighton Mills.
Paterson	John W. Ferguson	Paterson Nat. Bank Bldg.

PENNSYLVANIA.

Chester	W. T. Galey	Aberfoyle Manufg. Co.
Chester	D. Edwin Irving	The Irving & Leiper Manufg. Co.
Lancaster	S. S. Spencer	Conestoga Steam Mills.
Mt. Joy	Thomas J. Brown	George Brown's Sons.
Philadelphia	Robert Beatty	Coral and Adams Sts.
Philadelphia	T. Ashby Blythe	Ashby Cotton Mills.
Philadelphia	Alfred H. Burnham	Glasgow Mills.
Philadelphia	Harry W. Butterworth	H. W. Butterworth & Sons' Co.
Philadelphia	James Butterworth	H. W. Butterworth & Sons' Co.
Philadelphia	Frederick A. Downes	Factory Mutual Fire Insurance Co.
Philadelphia	Edward W. France	Philadelphia Textile School.
Philadelphia	Merrill A. Furbush	2015 North 33rd St.
Philadelphia	Joshua Garsed	Wingohocking Mills and National Spinning Co., Frankford.
Philadelphia	John T. Greenwood	R. Greenwood & Bault.
Philadelphia	Henry S. Grove	Argo Mills Co.
Philadelphia	W. C. Houston	Hope Mills Mfg. Co.
Philadelphia	John H. Lorimer	Ontario and Lawrence Sts.
Philadelphia	David Milne	Washington Ave. and 11th St.

Philadelphia	John R. Mitchell	Mitchell-Bissell Co.
Philadelphia	John K. Russell	3003 York St.
Philadelphia	Edward H. Sanborn	Cold Spring Bleach. & Fin. Works.
Philadelphia	Theodore C. Search	Cold Spring Bleach. & Fin. Works.
Philadelphia	George Wood	Millville Mfg. Co.
Philadelphia	John P. Wood	Spring Garden and 22nd Sts.
Philadelphia	Oscar W. Wood	Germantown Spinning Co.

DELAWARE.

Wilmington	William P. Bancroft	Joseph Bancroft & Sons Co
Wilmington	Daniel Moore Bates	Joseph Bancroft & Sons Co.

MARYLAND.

Baltimore	James A. Gary	Alberton Mills.
Baltimore	Charles K. Oliver	Mt. Vernon-Woodberry Cot. Duck Cc.
Ilchester	Samuel F. Patterson	Thistle Mills Co.

VIRGINIA.

Lynchburg	Theop. W. Wilmarth	Lynchburg Cotton Mill Co.

NORTH CAROLINA.

Charlotte	S. B. Alexander, Jr.	S. B. Alexander, Jr., Co.
Charlotte	Henry C. Clark	Charlotte Supply Co.
Charlotte	R. M. Miller, Jr.	Elizabeth Mills.
Charlotte	D. A. Tompkins	Atherton Cotton Mill.
Durham	O. W. Stites	Commonwealth Cotton Mfg. Co.
Fayetteville	Walter L. Holt	Holt-Morgan Mills.
Greensboro	Caesar Cone	Proximity Mfg. Co.
Greensboro	Edward T. Garsed	Hucomuga Mills.
Hope Mills	Frank H. Cotton	Hope Mills Mfg. Co.
Kings Mountain	F. Dilling	Dilling Cotton Mills.
Lincolnton	R. S. Reinhardt	Elm Grove Cotton Mills.
Mountain Island	W. T. Jordan	Mt. Island Manufg. Co.
West Durham	Edward W. Thomas	Erwin, Pearl, Dunham, Alpine and Cooleemee Cotton Mills.
Winston-Salem	John W. Fries	F. & H. Fries.

SOUTH CAROLINA.

Charleston	J. Colby Lewis	Vesta Cotton Mills.
Chester	William G. Nichols	Springstein Mills.
Columbia	James Sumter Moore	Olympia & Richland Cotton Mills.
Columbia	W. H. Rose	Granby Cotton Mills.
Columbia	W. B. Smith Whaley	Richland & Granby Cotton Mills.
Gaffney	H. D. Wheat	Gaffney Manufg. Co.
Graniteville	T. H. Rennie	Graniteville Mfg. Co.
Lancaster	Leroy Springs	Lancaster Cotton Mills.

Langley	Arthur T. Smith	Langley Manufg. Co. and Aiken Manufg. Co.
Laurens	O. B. Parker	Laurens Cotton Mills.
Newbury	Edward B. Wilbur	Mollohon Mfg. Co.
Orangeburg	Samuel Dibble	The Enterprise Cotton Mills.
Pelham	D. G. Sunderland	The Pelham Mills.
Pelzer	B. F. Guy	Pelzer Manufg. Co.
Pelzer	Ellison A. Smyth	Pelzer Manufg. Co.
Union	T. C. Duncan	Union Cotton Mills.

GEORGIA.

Atlanta	Samuel A. Carter	Gate City Cotton Mills.
Atlanta	C. E. W. Dow	Am. Moist. Co. and Wm. Firth Co.
Atlanta	W. L. Draper	Dodge Mfg. Co.
Atlanta	Oscar Elsas	Fulton Bag and Cotton Mills.
Atlanta	Henry E. Fisher	Atlanta Cotton Mills.
Atlanta	Harry W. Kimball	Fulton Bag and Cotton Mills.
Atlanta	D. E. McGaw	Supply Dept., Southern Belting Co.
Atlanta	William M. Nixon	Atlanta Woolen Mills.
Augusta	Thomas Barrett, Jr.	Langley & Aiken Mills.
Augusta	John W. Chafee	The Sibley Mfg. Co.
Augusta	Charles Estes	John P. King Mfg. Co.
Augusta	Arthur C. Freeman	Box 208
Augusta	T. I. Hickman	Graniteville Mfg. Co.
Augusta	Otis G. Lynch	Enterprise Manufg. Co.
Augusta	Joel Smith	J. P. King Mfg. Co.
Augusta	George R. Stearns	Riverside Mills.
Augusta	Eugene F. Verdery	Warren Mfg. Co.
Augusta	James P. Verdery	Enterprise Mfg. Co.
Chattahoochee	W. R. B. Whittier	Whittier Mills.
Columbus	E. N. Clemence	Eagle & Phenix Mills.
Columbus	Frederick B. Gordon	Columbus Mfg. Co.
Columbus	Charles H. Gorton	Columbus Mfg. Co.
Columbus	George W. Towne	Columbus Power Co.
East Point	Edward C. Beach	Gate City Cotton Mills.
Griffin, Spalding Co.	Albert G. Martin	Kincaid Manufg. Co.
Lindale	Henry P. Meikleham	Mass. Mills in Georgia.
Macon	W. H. Richmond	Bibb Mill No. 2.
Macon	Broadus E. Willingham	Willingham Cotton Mills.
West Point	Scott Maxwell	Lanett Mills.

TENNESSEE.

Knoxville	William T. Lang	Brookside Mills.
Knoxville	William Whittam, Jr.	P. O. Box 352.
Memphis	C. C. Cowan	372 Front St.

Memphis	Jerome Hill	Tennessee Planters' Co.
Nashville	T. B. Dallas	Phoenix Cotton Mills, and Dallas Mfg. Company.

MISSISSIPPI.

Agricultural College,	Arthur Whittam	Miss. Agricultural and Mechanical College.

LOUISIANA.

New Orleans	S. Odenheimer	Lane Mills.

KENTUCKY.

Henderson	Paul J. Marrs	Henderson Cotton Mills.
Louisville	Philip S. Tuley	Louisville Cotton Mills Co.

ALABAMA.

Birmingham	B. B. Comer	Avondale Cotton Mills.
Cordova	Joseph O. Hannum	Indian Head Mills of Ala.
Eufaula	James R. Pearce	Chewalla Cotton Mill.
Huntsville	T. W. Pratt	West Huntsville Cotton Mill Co.
Langdale	Charles M. Sears	West Point Mfg. Co.

TEXAS.

Galveston	Lawrence V. Elder	Galveston City Cotton Mills.

CANADA.

Province of Ontario.

Hamilton,	Charles Owen Dexter	The Canadian Colored Cotton Mills Co., Ltd.
Cornwall	S. Greenwood	The Canadian Colored Cotton Mills Co. Ltd.
Hamilton,	James M. Young	Hamilton Cotton Co.
Ottawa	Louis Simpson	Victoria Chambers.

Province of Quebec.

Hochelaga	W. S. Hume	176 Notre Dame St.
Montreal	Alfred Hawkesworth	Merchants Cotton Co.
Montreal	Fred Hawkesworth	Merchants Cotton Co.
Montreal	D. K. McLaren	751 Craig St.
Valleyfield	Ernest E. Clark	Montreal Cotton Co.
Valleyfield	Fred Lacey	Montreal Cotton Co.
Valleyfield	Charles H. Potter	Montreal Cotton Co.

NEW BRUNSWICK.

Marysville	John B. Cudlip	Gibson Cotton Mill.
Milltown	Lewis Dexter, Jr.	The Canadian Colored Cotton Mills Co., Ltd.
Milltown	Farquharson J. Muir	The Canadian Colored Cotton Mills Co., Ltd.
St. John	John H. Parks	Wm. Parks & Son, Ltd.

ENGLAND.

Matlock, Derbyshire,	John Edward Lawton	American Thread Co.
Huddersfield	John Sykes	English Card Clothing Co.

RECAPITULATION.

LOCATION OF MEMBERSHIP.

Maine	20
New Hampshire	31
Vermont	1
Massachusetts	309
Rhode Island	117
Connecticut	26
New York	24
New Jersey	11
Pennsylvania	25
Delaware	2
Maryland	3
Virginia	1
North Carolina	14
South Carolina	16
Georgia	29
Tennessee	5
Mississippi	1
Louisiana	1
Kentucky	2
Alabama	5
Texas	1
Province of Ontario	4
Province of Quebec	7
New Brunswick	4
England	2
	661

IN MEMORIAM.

JOHN WORTHINGTON DICKINSON, JR.

JOHN WORTHINGTON DICKINSON, JR., superintendent of Lyman Mills, Holyoke, Mass., died June 4, 1900. He was born at Westfield, Mass., his father being JOHN W. DICKINSON, formerly Secretary of the Massachusetts State Board of Education for many years. Moving to Newtonville, he attended the Newton High School and afterwards graduated from Harvard in 1884, soon after going to the Lyman Mills to learn the cotton business, where he became superintendent in 1889, which position he held until the time of his death, although he had several good positions offered him elsewhere which he never accepted.

He married in 1897 Miss ANNIE POTTER of Greenfield, Mass., and left no children.

He was a man of the greatest integrity and refinement, with a sunny nature, regular habits and was an inveterate worker and enthusiastic over all his undertakings.

He became a member of this Association Oct. 27, 1897.

GEORGE F. TRYON.

GEORGE F. TRYON, superintendent of the Conanicut Mills, died at his home in Fall River, Mass., Sept. 4, 1900.

He was born in Coventry, Conn., April 14, 1848, and entered the mill in early life, holding responsible positions at various places. He was a member of the Independent Order of Odd Fellows and the Mt. Vernon Lodge of Masons at Jewett City and of the Knights Templar of Fall River.

He was elected to membership in this Association April 28, 1897.

He contributed a paper on Slashing at the meeting April 27, 1898, which was considered a very important contribution to the subject.

In November, 1867, he married LETTIE M. REYNOLDS of Mansfield, Mass., who survives him.

DANIEL J. GILLIGAN.

DANIEL J. GILLIGAN, superintendent of the Pocasset Mfg. Co. of Fall River, Mass., died at Asheville, N. C., June 25, 1901. He was born in England, but came to this country when quite young and soon entered the work of cotton manufacturing and was identified with the Windham Mills at Willimantic, Conn., thence with the Border City Mills, Fall River, from which he went to the Pocasset Mfg. Co. He was possessed of a great deal of ambition and energy and devoted his efforts most assiduously to the interests of the mills under his charge. He left a widow and four children. He became a member of this Association April 29, 1896.

EFFINGHAM C. HAIGHT.

EFFINGHAM C. HAIGHT, treasurer of the Wampanoag Mills, Fall River, Mass., died July 18, 1901, at his summer home at Tiverton, R. I. He was born in New York, May 31, 1855, and his early life was spent upon a farm until the age of nineteen,

when he came to Fall River as bookkeeper in the office of the Wampanoag Mills. In 1889 he was chosen treasurer of the Stafford Mills. He went into business in New York, afterwards returning to Fall River as treasurer of the Wampanoag Mills. He married Miss KATHERINE W. BARKER, leaving her a widow and also two children. He became a member of this Association April 27, 1899. He was a man of exceptionally fine character and was very highly respected in the community.

STEPHEN GREENE.

STEPHEN GREENE died at his residence at Newton Centre, Mass., on Thursday, Nov. 7th, 1901. He had just returned from a trip to Europe, which was undertaken as a rest for his system, which was impaired by overwork.

He was born in Hope Village, Scituate, R. I., Sept. 27, 1851, his father, ALVIN GREENE, being a cotton manufacturer. He attended the public schools of Westerly and Brown University, from which he graduated in 1873 with the degree of bachelor of philosophy. He at once engaged in civil engineering and was employed by some of the leading engineers in Providence, finally entering the firm of Lockwood, Greene & Co., of which he was the surviving partner. In addition to his engineering work, he was in 1886 treasurer and general manager of the Whitefield Cotton Mills in Newburyport, which were since moved to South Carolina. In his profession as a mill engineer he designed, constructed and equipped a large number of mills, principally cotton mills. He was a director in a large number of manufacturing, insurance and educational corporations.

He was married in 1874 and leaves a wife and four sons. He became a member of this Association Oct. 27, 1886, and his contributions of papers, although rendered infrequent by the responsibilities of a very busy life, were highly appreciated.

PROCEEDINGS.

In accordance with legal notice the stated semi-annual meeting of the Association was held in the International Hotel, Niagara Falls, N. Y., Sept. 25-26, 1901. The following 81 members and 103 guests were present:

ACTIVE MEMBERS.

FREDERICK K. ALLEN, Camden, Me.
THOMAS ARMSTRONG, North Pownal, Vt.
H. C. ATWOOD, Killingly, Conn.
GEORGE A. AYER, New Bedford, Mass.
LEWIS E. BARNES, Methuen, Mass.
EDWIN N. BARTLETT, North Oxford, Mass.
JOHN P. BODGE, Fall River, Mass.
WILLIAM H. CADWELL, Nashua, N. H.
BYRON F. CARD, Boston, Mass.
S. A. CARTER, Atlanta, Ga.
CLARENCE N. CHILDS, Lowell, Mass.
FRANK B. COMINS, Boston, Mass.
P. T. CREED, Taunton, Mass.
CHARLES A. DENNY, Leicester, Mass.
GEORGE OTIS DRAPER, Hopedale, Mass.
WILLIAM FIRTH, Boston, Mass.
CHARLES H. FISH, Dover, N. H.
M. F. FOSTER, Milford, N. H.
EDWARD T. GARSED, Greensboro, N. C.
D. W. GRAY, Utica, N. Y.
ARTHUR H. GULLIVER, Waltham, Mass.

FRANK J. HALE, Newton Upper Falls, Mass.
JOHN F. HAMLET, Fall River, Mass.
FRED LACEY, Valleyfield, P. Q.
SCOTT MAXWELL, West Point, Ga.
WILLIAM G. McLOON, Clinton, Mass.
WILLIAM P. McMULLAN, Salem, Mass.
JAMES I. MILLIKEN, Lawrence, Mass.
A. B. MOLE, Adams, Mass.
EDWARD A. MONGEON, Lonsdale, R. I.
J. R. MONTGOMERY, Windsor Locks, Conn.
FRED W. MOORE, Millbury, Mass.
ALBERT H. MORTON, Lowell, Mass.
E. P. MORTON, Webster, Mass.
WILLIAM G. NICHOLS, Chester, S. C.
ALBERT W. NOONE, Peterboro, N. H.
JOHN E. PREST, Cohoes, N. Y.
M. W. QUINN, Amesbury, Mass.
T. H. RENNIE, Graniteville, S. C.
CHARLES D. ROBINSON, Crompton, R. I.
ARNOLD SCHAER, Warren, R. I.
CHARLES M. SEARS, Langdale, Ala.
JOEL SMITH, Augusta, Ga.
J. C. SMITH, Fall River, Mass.
D. A. TOMPKINS, Charlotte, N. C.
OSCAR B. TRUESDELL, Newtonville, Mass.
JOSEPH WATTERS, Fall River, Mass.
JOHN B. WILD, Utica, N. Y.
C. J. H. WOODBURY, Lynn, Mass.
ADELBERT R. YOUNG, Jewett City, Conn.

ASSOCIATE MEMBERS.

F. H. BISHOP, Boston, Mass.
J. FRANK BRAIDS, Providence, R. I.
HENRY G. BRINCKERHOFF, Boston, Mass.
EUGENE E. BURNHAM, Lawrence, Mass.
HARRY W. BUTTERWORTH, Philadelphia, Pa.
CHARLES H. CHILD, Providence, R. I.
E. W. DAVENPORT, Providence, R. I.
C. E. W. DOW, Atlanta, Ga.

W. L. DRAPER, Atlanta, Ga.
T. C. ENTWISTLE, Lowell, Mass.
H. P. GARLAND, Biddeford, Me.
ALFRED H. HARTLEY, Fall River, Mass.
LEWIS T. HOUGHTON, Worcester, Mass.
A. H. HOWARD, Worcester, Mass.
FRANK B. KENNEY, Lowell, Mass.
STEPHEN C. LOWE, New Bedford, Mass.
FAY H. MARTIN, Hyde Park, Mass.
CHARLES B. MOORE, Boston, Mass.
WILLIAM R. NOONE, Boston, Mass.
STEPHEN MINOT PITMAN, Providence, R. I.
VLADIMIR P. POLEVOY, New York, N. Y.
PELEG A. RHODES, Providence, R. I.
R. PAUL SNELLING, Newton Upper Falls, Mass.
H. E. STAFFORD, Providence, R. I.
JAMES STRANG, Indian Orchard, Mass.
JAMES T. THORNTON, Providence, R. I.
RIENZI W. THURSTON, Fall River, Mass.
ALLISON W. TRAFFORD, Fall River, Mass.
WILLIAM R. WEST, New Bedford, Mass.
FRED A. WILD, Pawtucket, R. I.
ERVING YALE WOOLLEY, Boston, Mass.

GUESTS.

J. N. ADAM, Buffalo, N. Y.
B. W. ANTHONY, Fall River, Mass.
C. W. ATWOOD, Killingly, Conn.
H. B. ATWOOD, Killingly, Conn.
W. W. BALLAGH, New York, N. Y.
FRANK P. BENNETT, JR., Boston, Mass.
MORRIS BENSON, Buffalo, N. Y.
C. B. BURLEIGH, Boston, Mass.
FRANK H. BURT, Boston, Mass.
P. F. CLEED, Macon, Ga.
M. H. COFFIN, Whitinsville, Mass.
S. S. DALE, Boston, Mass.
GEORGE W. FARNHAM, Buffalo, N. Y.
T. F. FARNSWORTH, Providence, R. I.

Hon. N. J. W. Fish, Taunton, Mass.
Jeremiah Goff, Charlotte, N. C.
Almon M. Granger, Buffalo, N. Y.
Alfred Haines, Buffalo, N. Y.
George Harmon, Suffield, Conn.
William H. Harriss, Charlotte, N. C.
M. A. Hays, Boston, Mass.
Frederick W. Howe, Providence, R. I.
Robert R. Hefford, Buffalo, N. Y.
A. R. James, Buffalo, N. Y.
F. M. K. Jones, Boston, Mass.
J. B. Jones, Philadelphia, Pa.
W. A. Joyce, Buffalo, N. Y.
Roland R. Kenner.
V. P. Kinne, Buffalo, N. Y.
F. C. M. Lantz, Buffalo, N. Y.
Ogden P. Letchworth, Buffalo, N. Y.
John Maddocks, Bradford, England.
F. Howard Mason, Buffalo, N. Y.
E. McDonald.
J. J. McWilliams, Buffalo, N. Y.
Thomas H. Meek, Whitinsville, Mass.
E. D. Meier, New York, N. Y.
Hon. John G. Milburn, Buffalo, N. Y.
Hon. F. T. Moore, Pt. Huron, Mich.
W. C. Nairn, Lawrence, Mass.
W. P. W. Pomeroy, Buffalo, N. Y.
H. F. J. Porter, New York, N. Y.
Robert K. Root, Buffalo, N. Y.
Henry H. Seymour, Buffalo, N. Y.
H. P. Thompson, Boston, Mass.
Prof. R. H. Thurston, Ithaca, N. Y.
Curt M. Treat, Buffalo, N. Y.
I. A. Whitcomb, Somerville, Mass.
William H. Wild, Utica, N. Y.
Master Jack Wild, Utica, N. Y.
C. H. Wilson, Niagara Falls, N. Y.
Mrs. B. W. Anthony, Fall River, Mass.
Mrs. Thomas Armstrong, No. Pownal, Vt.

Mrs. H. C. Atwood, Killingly, Conn.
Mrs. E. H. Benson, Pt. Huron, Mich.
Mrs. J. P. Bodge, Fall River, Mass.
Mrs. Henry G. Brinckerhoff, Boston, Mass.
Mrs. C. B. Burleigh, Boston, Mass.
Mrs. H. W. Butterworth, Philadelphia, Pa.
Mrs. W. H. Cadwell, Nashua, N. H.
Mrs. Byron F. Card, Boston, Mass.
Mrs. M. H. Coffin, Whitinsville, Mass.
Miss Bertha Denny, Leicester, Mass.
Mrs. Henry J. Duncan, Lynn, Mass.
Mrs. Charles H. Fish, Dover, N. H.
Mrs. F. P. Fish, Brookline, Mass.
Mrs. Mary J. Fish, Taunton, Mass.
Mrs. H. P. Garland, Biddeford, Me.
Miss Evelyn Garrett, New Bedford, Mass.
Mrs. John F. Hamlet, Fall River, Mass.
Mrs. George Harmon, Suffield, Conn.
Mrs. Lewis T. Houghton, Worcester, Mass.
Mrs. A. H. Howard, Worcester, Mass.
Mrs. Frank B. Kenney, Lowell, Mass.
Mrs. Stephen C. Lowe, New Bedford, Mass.
Miss Esther S. Lowe, New Bedford, Mass.
Mrs. William G. McLoon, Clinton, Mass.
Mrs. William P. McMullan, Salem, Mass.
Mrs. J. I. Milliken, Lawrence, Mass.
Mrs. E. A. Mongeon, Lonsdale, R. I.
Miss Florence F. Mongeon, Lonsdale, R. I.
Mrs. J. R. Montgomery, Windsor Locks, Conn.
Mrs. Charles B. Moore, Boston, Mass.
Mrs. Fred W. Moore, Millbury, Mass.
Mrs. Albert H. Morton, Lowell, Mass.
Mrs. Vladimir P. Polevoy, New York, N. Y.
Mrs. John E. Prest, Cohoes, N. Y.
Miss Jessie Prest, Cohoes, N. Y.
Mrs. Frank P. Rhodes, Providence, R. I.
Miss Isabelle Rhodes, Providence, R. I.
Mrs. Charles D. Robinson, Crompton, R. I.
Mrs. Joel Smith, Augusta, Ga.

Mrs. J. C. SMITH, Fall River, Mass.
Miss ALBERTA THOMES, Manchester, N. H.
Mrs. RIENZI W. THURSTON, Fall River, Mass.
Mrs. ALLISON W. TRAFFORD, Fall River, Mass.
Mrs. R. M. TRAFFORD, Fall River, Mass.
Mrs. JOSEPH WATTERS, Fall River, Mass.
Miss ELSIE WEST, New Bedford, Mass.
Mrs. WILLIAM R. WEST, New Bedford, Mass.
Mrs. I. A. WHITCOMB, Somerville, Mass.
Mrs. FRED A. WILDE, Pawtucket, R. I.
Miss ALICE P. WOODBURY, Lynn, Mass.

PRELIMINARY NOTICE.

To the Members:

Volume No. 70 of the Transactions, being the report of the Boston meeting, April 24-25, is sent you. Kindly receipt for the same on the enclosed postal card and also please examine your name and address in the list of members in the first portion of the Transactions following page 12, and inform the Association of any correction which may be necessary. Members are especially requested to inform the Association of any changes in address.

REPRINT OF TRANSACTIONS.

The supply of copies of volume No. 56 of the Transactions, April 25, 1894, has been exhausted on account of the demand for the report of the Committee on Costs which it contains. The Board of Government are to reprint that volume, but the addition will be based upon the number of members desiring it. A copy will be sent, without extra charge, to any member applying for the same before August 1st, at which date the order for printing will be given and after that time there will be a charge of 50 cents per volume to the members for the few remaining copies which will be printed in excess of this demand.

AUTUMN MEETING.

ITINERARY.

From Boston, train of Pullman, special drawing-room cars will leave the South Terminal Station, September 24, at 9.00 A. M., via the Boston & Albany Railroad and the New York Central Railroad. Lunch and dinner en route. Arrive at Niagara Falls 10.30 P. M. Transfer to the International Hotel.

Leave New York from the Grand Central Station, September 24, at 8.45 A. M. via the New York Central Railroad in Pullman drawing-room cars, meals en route. Arrive at Niagara Falls 8 P. M. Transfer to International Hotel.

Leave Philadelphia from the Reading Terminal Station, September 24 via the Lehigh Valley Railroad 10.30 A. M., in drawing-room cars, meals en route. Arrive at Niagara Falls 9.00 P. M. Transfer to International Hotel.

Sessions will be held in the hall of the International Hotel, Wednesday and Thursday, September 25-26, at 9.00 A. M. and 8.30 P. M, in order to give the members as much time as possible to visit the Pan-American Exposition at Buffalo, and the attractions at Niagara Falls.

The opening address will be delivered by Dr. ROBERT H. THURSTON, Dean of Sibley College, Cornell University.

The excursion tickets include one for the trolley car trip, starting from Niagara Falls near the International Hotel and crossing over the bridge to the Canadian side visiting the Canadian Falls, thence along the top of the bluffs to Queenstown, crossing the Niagara River to Lewiston, and returning on the American side at the base of the Gorge to the point of departure at Niagara Falls.

There is no stated time for this trip, as it was believed that members would find it preferable to go independently, as the cars leave at frequent intervals.

The tower at Niagara Falls furnishes an excellent opportunity to obtain a bird's-eye view of the scenery along the Niagara River and for many miles on both sides. The banks on both sides of the river and the islands which divide the Falls are now a public park, open freely to all visitors.

The Niagara Falls Power Company extend a cordial invitation to inspect the power house and plant of that company, during the meeting, the day and hour to be appointed later.

The officers of the Pan-American Exposition and officers and members of the Merchants' Exchange of Buffalo will informally receive the members of the Association at the Temple of Music, which is the official building on the grounds, on the afternoon of either Wednesday or Thursday at an hour to be appointed later.

The New York Central Railroad runs rapid transit trains at short intervals, conducting one to the Pan-American grounds in thirty minutes. It is suggested that at least one trip should be made between Niagara

Falls and Buffalo by the trolley route which, running along the banks of the Niagara River above the falls, affords scenic views not in the usual route of tourists.

Friday, September 27th, leave Niagara Falls at 7.30 A. M. in drawing-room cars, meals en route, arriving at South Terminal Station, Boston, 9.00 P. M., arriving at Grand Central Station, New York, 6.30 P. M., arriving at the Reading Terminal Station, Philadelphia, 7.20 P. M.

The rates for this excursion from Boston, New York or Philadelphia, will be $42.00, or by remaining until 7.30 A. M. Tuesday, October 1st, the rates will be $64.00. Bath rooms, $2.00 per day extra for each room.

For those desiring to return independently, tickets will be made good until October 31st; from other points proportional rates will be given. For tickets, address Messrs. Raymond & Whitcomb, 296 Washington Street, Boston, Mass., who will arrange tickets for returning by other routes, especially by the International Navigation Company to Toronto and down the St. Lawrence River by the Richlieu & Ontario Navigation Company, among the Thousand Islands and through all the rapids, returning by way of Montreal or Quebec.

Railroads are issuing round trip tickets at reduced rates from all points. Those who desire to obtain their railroad tickets independently can arrange to travel on the special trains and obtain their parlor car, meal and hotel accommodations from Messrs. Raymond & Whitcomb.

On account of the difficulty of obtaining suitable accommodations and also the importance of securing for members of the Association satisfactory rooms, tickets for this excursion will be sold only to the members and their guests, unless a week in advance of the meeting there should be room for others.

The Visitor's Information Company, 540 Ellicott Square, Buffalo, N. Y., was organized for the purpose of adding to the convenience of visitors to the Pan-American Exposition, and is officially endorsed by the authorities of the fair. On receipt of one dollar they will give you an identification number, and mail or telegrams may be sent to their address at the fair, and subscribers are notified that communications are awaiting them, by means of their number being posted on bulletin boards in various parts of the grounds. They send a hand book and maps of the fair and will furnish car and carriage service, guides both in and out of the fair, arrange tallyho and bicycle rides. Stationery and other services are at their headquarters in the grounds.

Rand, McNally & Company, Chicago, Ill., publish a handbook to the Pan-American Exposition and Niagara Falls at 25 cents, which is on sale at news stands.

By order of the Board of Government,

C. J. H. WOODBURY,

July 1, 1901. *Secretary.*

FIRST SESSION.

INTERNATIONAL THEATRE,
NIAGARA FALLS, N. Y.,
WEDNESDAY, September 25, 1901.

Meeting called to order at 9 A. M., President CHARLES H. FISH in the chair.

The Secretary read the following call for the meeting:

CALL TO PAN-AMERICAN SEMI-ANNUAL MEETING, NO. 71,
INTERNATIONAL HOTEL, NIAGARA FALLS, N. Y.

BOSTON, MASS. September 3, 1901.

To the Members:

Notice is hereby given that the stated Semi-Annual Meeting of this Association will be held at Niagara Falls, N. Y., on Wednesday and Thursday, September 25-26, 1901. The sessions will be held in the parlors of the International Hotel at 9 A. M. and 8.30 P. M.

By order of the Board of Government,

C. J. H. WOODBURY,
Secretary.

The first session will be called to order at 9 A. M. on Wednesday, when the members of the Association will be welcomed by His Honor, Mayor MIGHELLS B. BUTLER, and other persons interested in the Association.

The detailed programme will not be issued until the meeting, but the arrangements in addition to the programme at the sessions will include a visit on Wednesday at 11 A. M., to the Plant of the Niagara Falls Power Company, where the water power of Niagara is converted into electricity, which is applied to a great many uses in industrial chemistry as well as lighting and power for many miles from Niagara Falls.

An informal reception will be given to the members of the Association and guests at the Temple of Music, which is the Official Building of the Pan-American Exposition, by Officers of the Pan American Exposition and of the Buffalo Merchants' Exchange, at a date and hour to be announced on the programme.

Papers are expected on the following subjects:

The Manufacturing Industries: Their Relations to National Position and Progress.
The Past, Present and Future of the Cotton Industry of Japan.
The Niagara Falls Power Plant.
The Cotton Fibre in Some of Its Phases.
The Round Bale at the Mill.
Overworking of Cotton in the Card Room.
Cotton Waste.
Knitting Industry in the United States.
The Evolution of the Slubbing Frame.
Thread Boards and Guides.
Steel Forgings for Factory Engines.
Early Southern Cotton Mills.
The Possibilities of Trade Expansion in Cotton Manufactures.
Modern Boiler Problems.

The general arrangements for the trip will be as follows:

ITINERARY.

From Boston, train of Pullman special drawing-room cars will leave the South Terminal Station September 24, at 9.00 A. M., via the Boston & Albany Railroad and the New York Central Railroad. Lunch and dinner en route. Arrive at Niagara Falls 10.30 P. M. Transfer to the International Hotel.

Leave New York from the Grand Central Station, September 24, at 8.45 A. M. via the New York Central Railroad in Pullman drawing-

room cars, meals en route. Arrive at Niagara Falls 8 P. M. Transfer to the International Hotel.

Leave Philadelphia from the Reading Terminal Station, September 24, at 10.30 A. M. via the Lehigh Valley Railroad, in Pullman drawing-room cars, meals en route. Arrive at Niagara Falls 9 P. M. Transfer to the International Hotel.

Sessions will be held in the hall of the International Hotel, Wednesday and Thursday, September 25-26, at 9 A. M. and 8.30 P. M., in order to give the members as much time as possible to visit the Pan-American Exposition at Buffalo, and the attractions at Niagara Falls.

The excursion ticket includes one for the trolley car trip, starting from Niagara Falls near the International Hotel and crossing over the bridge to the Canadian side visiting the Canadian Falls, thence along the top of the bluffs to Queenstown, crossing the Niagara River to Lewiston, and returning on the American side at the base of the Gorge to the point of departure at Niagara Falls.

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Friday, September 27th, leave Niagara Falls at 7.30 A. M. in drawing-room cars, meals en route, arriving at South Terminal Station, Boston, 9 P. M., arriving at Grand Central Station, New York, 6.30 P. M., arriving at the Reading Terminal Station, Philadelphia, 7.20 P. M.

The rates for this excursion from Boston, New York or Philadelphia will be $42, or by remaining until 7.30 A. M. Tuesday, October 1st, the rates will be $64. Bath rooms, $2 per day extra for each room.

The representative of Raymond & Whitcomb will give, without extra charge, to persons purchasing these excursion tickets, round trip tickets by the New York Central & Hudson River Railroad from Niagara Falls to Buffalo and return, each day.

For those desiring to return independently, tickets will be made good until October 31st; from other points proportional rates will be given. For tickets, address Messrs. Raymond & Whitcomb, 296 Washington St., Boston, Mass., 25 Union Square, New York, N. Y., or 1005 Chestnut St., Philadelphia, Pa., who will arrange tickets for returning by other routes, especially by the International Navigation Company to Toronto and down the St. Lawrence River by the Richlieu & Ontario Navigation Company, among the Thousand Islands and through all the rapids, returning by way of Montreal or Quebec.

Railroads are issuing round trip tickets at reduced rates from all points. Those who desire to obtain their railroad tickets independently can arrange to travel on the special trains and obtain their parlor car, meal and hotel accommodations from Messrs Raymond & Whitcomb.

A blank proposition for membership is enclosed for convenience in submitting the names of any who would be desirable members. Many persons have not become members because they have never been invited. Candidates for membership will be entitled to the privileges of the trip. Blank propositions are also inside the front cover of the Transactions, or will be sent on application.

It is important that the Association should be promptly informed of changes of address of any members.

The SECRETARY. In accordance with Article 14 of the by-laws, I certify that this call was mailed to each member at least ten days before the meeting and that a quorum is now present.

The records of the last meeting were read by the Secretary, and on motion of Mr. CHARLES M. SEARS, duly seconded, the same were accepted.

The following is the programme of the meeting:

PAN-AMERICAN SEMI-ANNUAL MEETING, NO. 71, INTERNATIONAL HOTEL, NIAGARA FALLS, N. Y., SEPT. 25-26, 1901.

First Session,

Wednesday, September 25, 1901, at 9 A. M., at International Theatre.

Call to Order.

Welcome to the Association.

HIS HONOR MICHELIS B. BUTLER, Mayor of Niagara Falls.

President's Address.

CHARLES H. FISH, Dover, N. H.

The Manufacturing Industries: Their Relations to National Position and Progress.

ROBERT H. THURSTON, A. M., LL. D., Dean of Sibley College, Cornell University, Ithaca, N. Y.

The Past, Present and Future of the Cotton Industry in Japan.

HACHIRO H. FUKUHARA, Tokio, Japan.

The Plant of the Niagara Falls Power Company.
(Illustrated by lantern slides.)

PHILIP P. BARTON, Niagara Falls, N. Y.

At 11 A. M. the session will be adjourned and the party will take electric cars to the plant of the Niagara Falls Power Company where guides will be furnished to explain the hydraulic and electrical apparatus.

The members of the party can then go to Buffalo by trolley; or return to Niagara Falls by trolley and take the New York Central & Hudson River Railroad train for Buffalo.

Second Session, Wednesday, September 25, 1901, at 8.30 P. M.

The Cotton Fibre in Some of its Phases.

HENRY G. KITTREDGE, Boston, Mass.

The Round Bale at the Mill.

W. S. SOUTHWORTH, Lowell, Mass.

Overworking of Cotton in the Card Room.

EDWARD W. THOMAS, West Durham, N. C.

Cotton Waste.

COL. SAMUEL WEBBER, Charlestown, N. H.

Third Session, Thursday, September 26. 1901, at 9 A. M.

Thread Boards and Guides.

LEWIS T. HOUGHTON, Worcester, Mass.

Knitting Industry in the United States.

ALBERT DEABILL, Lowell, Mass.

The Evolution of the Slubbing Frame.

FRANK P. BENNETT, Jr., Boston, Mass.

Fourth Session, Thursday, September 26, 1901, at 3 P. M.

Officers of the Pan American Exposition and the Merchants' Exchange and Citizens of Buffalo will give an informal reception at the New York State Building at the Pan-American Exposition, at which it is hoped that all of the party will be present.

Fifth Session, Thursday, September 26, 1901, at 8.30 P. M.

Election of New Members.

Steel Forgings for Factory Engines.
(Illustrated by lantern slides.)
H. F. J. PORTER, 100 Broadway, New York City.

Early Southern Cotton Mills.
D. A. TOMPKINS, Charlotte, N. C.

The Possibilities of Trade Expansion in Cotton Manufactures.
WILLIAM WHITTAM, Jr., Knoxville, Tenn.

Modern Boiler Problems.
COL. E. D. MEIER, 11 Broadway, New York City.

The SECRETARY. Mr. President, I have several notices to give. After the adjournment of this meeting, at about 11 o'clock, special street cars will take the party to the power house of the Niagara Falls Power Company to examine the great electric generating plant. The cars will start from the front of this building, and it is hoped that all may be present.

The arrangements for the reception by the Pan-American officials and the officers of the Board of Trade of Buffalo were somewhat disturbed by the great calamity which occurred at that Exposition. However, it was deemed advisable by them that the arrangements should be carried out, but with the change that instead of the Temple of Music, the reception will be held at the New York State Building at three o'clock tomorrow afternoon.

The Raymond & Whitcomb tickets include a trolley trip down the Gorge, which requires about two hours. There are two

ways of taking the Belt Line Circuit: one to go down the Gorge first and return up the Canadian side, but the other one is preferable. Take the electric cars across to the Canadian side first, thence up to the Horseshoe Falls, where the car turns around a loop and returns along the top of the bluff to Queenston, where it crosses the river to Lewiston and comes up the Gorge. This allows one to face the rapids when returning and also to have a view of the Falls. In this connection I would suggest that whenever the air is clear and you have the opportunity, you take the elevator up the large tower which is opposite this building. The view is a very fine one of the whole surrounding country.

The Natural Food Company will send to each one of the party an invitation to inspect their works which are at the southern portion of the city on Buffalo Avenue near to the Niagara River. While the product of this establishment may be of especial interest to the ladies, the members will find the building a very interesting sample of modern mill construction, abounding in novelties of arrangement and methods of illumination, heating and ventilating, the whole area being about 1¼ acres.

The Board of Government direct the Secretary to make, on their behalf, a report upon another matter. At the Montreal meeting Mr. M. F. FOSTER read a paper on Rocky Hill Creek Farm, three miles from Augusta, Ga., where WHITNEY'S cotton gin was first put into practical operation, and suggested that some memorial should properly be placed by this Association on those grounds. Within a few months a number of gentlemen of Augusta have purchased that property as a memorial to WHITNEY, and it is to be used as a country club. The acquisition of title to the property with its promise of permanence, gave a better phase to the proposition of Mr. FOSTER, and it is proposed as a tentative matter to consider the propriety of erecting on that building a bronze tablet in commemoration of the first ginning of American cotton by means of grids and of bent wire, as a matter which has been of so much importance to the wel-

fare of the United States and the prosperity of the world. The cost of such a tablet of artistic design and construction would be at least $750.00. The Board of Government, in pursuance of a policy that the dues in this Association are properly a trust for the members, which is returned to them in the Transactions and in the meetings, did not feel that it was wise or proper to make any such appropriation, but thought that funds for such a purpose ought to be, if approved of by the members, raised by a popular subscription of a little from each one. And with that the matter is submitted for the consideration of the meeting.

Mr. GEORGE OTIS DRAPER. Mr. President, I wish to offer the following resolution in regard to this matter:

Resolved, That this Association cordially approves the proposition to erect a tablet at Rocky Creek, Georgia, in commemoration of the work of ELI WHITNEY in establishing the ginning of American cotton, and refers this matter to the Board of Government, granting authority to solicit subscriptions from the membership to defray the cost, and to take such measures as may be necessary in the construction and preservation of such a tablet under conditions which shall insure its future care.

The PRESIDENT. Gentlemen, you have heard the resolution offered by Mr. DRAPER. What would you like to say in connection with it? If any one has any remarks to make on this subject, we shall be pleased to hear them.

Mr. JOHN E. PREST. Mr. President, it seems to me we ought to have more time to consider this question. It ought to be brought up when we have a full meeting for the expression of opinion, that we may see what the Association thinks best to do about it. It seems to me we are hurrying matters a little. There are other people, I think, who might take an interest in this as well as the Cotton Manufacturers' Association. The Cotton Planters' Association is interested in it as much as we are. We ought to consider it further before taking action.

The PRESIDENT. As I understand it, Mr. PREST, your suggestion is that we wait until a future meeting?

Mr. JOHN E. PREST. Yes, sir.

The PRESIDENT. Of course you will understand that the resolution, if I understand it correctly, does not prohibit any one else, the Planters' or any other association, from doing a similar thing. I should like to hear from some other member, if you please, in reference to it.

MR. JOHN E. PREST. There are so few members here at the present time that I think it should be taken up when there are more members here to discuss the matter further.

Mr. CHARLES A. DENNY. It seems to me, Mr. President, that it would be a very excellent thing for this Association to erect this memorial, and if the premises are now open as a club, it would be an added inducement for us to do it in some proper manner. Personally, my first thought was that it would be well for us to make an appropriation from the funds of the Association. Yet, thinking of it, perhaps that might not be agreeable to every member, and if it is better for it to be laid upon the table until a future session, that might be done. But I should hope that some action will be taken at this convention that would lead to the result of establishing that recommendation or suggestion of the Board of Government. I hope it will not be postponed to another meeting of the Association if it is laid upon the table and I do not think that my friend, Mr. PREST, so intended. It might be laid over until a later session if it is thought best. I hope it will be done.

The PRESIDENT. Gentlemen, what shall we do with this? Has any one a motion to make in connection with it?

Mr. JOHN F. HAMLET. Mr. President, I move that the resolution be laid upon the table and made the subject of the first order of business at the session at the hotel this evening.

The motion was seconded and the question stated by the chair.

Mr. CHARLES A. DENNY. Mr. President, the thought came to me whether some members who are obliged to go home on Friday might not be in Buffalo this evening, so that we might have a larger meeting tomorrow morning. I should think the officers would know better about the prospects. If this evening is likely to be the larger, all right; otherwise I would just as soon have it tomorrow morning.

Mr. JOHN E. PREST. I would suggest that we let this matter rest and take it up when we have a fuller meeting, either tonight or tomorrow morning, I will not say which.

The PRESIDENT. The motion is already made, as I understand it, that we take this up as the first order of business this evening. That motion is made and seconded and question is put.

Mr. CHARLES A. DENNY. I did not desire to amend the motion because it may not be wise. Our Secretary says it may be doubtful when we shall have the largest attendance.

Mr. JOHN E. PREST. If there is no objection I would move to amend the motion so that the resolution be taken up at the pleasure of the chair, either tonight or tomorrow morning.

The motion was seconded, and being put to vote was declared carried; and the further consideration of the resolution was accordingly postponed, to be taken up at a future session at the pleasure of the chair.

Mr. ARTHUR H. GULLIVER. Mr. President, it seems to me fitting on this occasion, when we are assembled near Buffalo, where we have suffered recently a great loss in the death of President MCKINLEY, that we take some action on this calamity, and I therefore move that a committee be appointed by the chair to draw up suitable resolutions and present these resolu-

tions before the close of the meeting now in session here at Niagara Falls.

The PRESIDENT. Gentlemen, you have heard the motion of Mr. GULLIVER that a committee be appointed — did you mention the number, Mr. GULLIVER?

Mr. ARTHUR H. GULLIVER. Mr. President, I would suggest that a committee of three be appointed by the chair.

The PRESIDENT. The motion is that a committee of three be appointed by the chair to draw up and present a set of resolutions upon the death of President MCKINLEY, the same to be acted upon before the close of this meeting.

The motion was put to vote and carried, and the chair appointed as such committee Messrs. ARTHUR H. GULLIVER, J. R. MONTGOMERY and M. F. FOSTER.

WELCOME TO THE ASSOCIATION.

HON. MIGHELLS B. BUTLER, Mayor of City of Niagara Falls.

Mr. President, ladies and gentlemen: It gives me great pleasure to greet you with a most hearty welcome, and I trust that your meeting here will be so enjoyable and beneficial that you will soon again visit us. We have so much (too much one of your number has just said) to offer you by way of entertainment and study that you cannot but be pleased. In our city you find at once the grandest natural features as well as the most remarkable development of power to be found in the world. The natural features embracing a broad and swiftly flowing river, rapids, the cataract itself and the waters below the cataract rushing madly on their way to Ontario. Also you see a beautiful park and islands connected by artistic bridges, and below the falls the great gorge spanned by two arches, a cantilever and a suspension bridge, all built of steel and each a marvel of engineering skill.

But you, from the very nature of your business life, will doubtless be as greatly interested in seeing how man's ingenuity and indefatigable energy has harnessed Niagara and transformed its limitless water power into electrical energy with which to turn the wheels of industry in our own and in neighboring cities. The wonderful electrical display at the Pan-American Exposition is possible only because of Niagara power.

You will see dozens of factories of various kinds in active operation and nearly as many more in process of construction, showing the healthy and rapid strides we are making in the commercial world.

Among the factories nearly finished, that of the Natural Food Company on Buffalo Avenue overlooking the upper rapids is especially worthy of your attention. It is the largest and finest building in the world devoted to the preparation of food products and is a model in its various appointments. The management extends a cordial invitation to you to inspect their plant and it is certainly to be considered one of the important points of interest in our city.

As to the matter of power let me tell you that we have already developed eighty thousand horse power and to that fifty thousand more will be added within a few months, while that amount will be further increased within about two years to upwards of two hundred thousand, to say nothing of at least fifty thousand in addition now being developed just across the river. You must certainly realize how bright the future is for us with such a wealth of energy at our doors only awaiting use.

May we not, with the utmost confidence, say that within a very few years ours will be the largest manufacturing city in the world? We have combined with the cheapest power most excellent shipping facilities. Nine Trunk Lines pass our doors, while water transportation via the great lakes and the canal is to be had with little expense. The population of eight states bordering upon our inland seas is upwards of thirty-three millions, while within a radius of five hundred miles there is a population of forty-five millions to be provided for, and the yearly increase is rapid. With these facts I earnestly trust that many of your members will be so interested in us that you will find it to your advantage to arrange at once to select sites for cotton mills. We want your kind of factory and we feel that it will be only a short time before cotton and other fabrics will be manufactured in our city.

Consider well the many advantages we offer you and I feel satisfied you will soon be here with us.

Again let me bid you welcome and extend to you the freedom of the city, hoping and believing that your deliberations will be full of pleasure as well as of profit.

PRESIDENT'S ADDRESS.

CHARLES H. FISH, Dover, N. H.

Gentlemen, you have heard the cordial greeting of His Honor, Mayor Butler, and not only in behalf of the Association, but in behalf of each as individuals, I return to him our most sincere thanks for the kind expressions.

From time immemorial old Niagara has thundered on, dashing itself to pieces against its own solid foundations, an awe-inspiring example of uncontrolled energy.

It still thunders on, but bridled and saddled and under the perfect control of man, it patiently turns the wheel of industry — white coal consumed by water wheels.

It is well for us to assemble at this place and we thank kind Providence for guiding us aright.

You may, your Honor, be sure that we appreciate your welcome, and the many advantages which this far-famed locality affords.

Gentlemen of the New England Cotton Manufacturers' Association, it now becomes my pleasant duty to welcome you to the seventy-first meeting of this Association. Thirty-six years ago the New England Cotton Manufacturers' Association held its first meeting at Young's Hotel in Boston, having at that time a membership of forty-four, representing four states: Maine, New Hampshire, Massachusetts and Rhode Island.

Today we meet with a membership of six hundred and forty-four, representing twenty-one states, besides England, the Provinces of Ontario, Quebec and New Brunswick.

It would seem, therefore, that we have really outgrown our

name "The New England Cotton Manufacturers' Association," and sooner or later it may be desirable to consider the advisability of adopting a new name, which would indicate, in a way, our broadened boundaries and our broadened influence.

We must in the end consist of one mighty organization, extending from the factories of the far North to the factories of the extreme South, and from the Atlantic to the Pacific.

As we continue to increase our boundaries and our membership, so must we increase our scope of usefulness. The ideal cotton manufacturer of the future, and I may say of today, is one who not only understands the arts of spinning and of weaving the cotton fibre, but is also proficient, at least to some extent, in the different branches of engineering. He must understand excavations, foundation work, and construction of all kinds. He must be able to figure for himself the strength of materials. He must be able to estimate the power required, and the power consumed. He must know the water wheel, the steam engine, and the application of gas, compressed air, and electricity; and so it is that the cotton manufacturer must always be, in a way, a mechanical engineer, an electrical engineer, and I believe in most localities a knowledge of political engineering will not come amiss.

In following out this thought, I would recommend most strongly the fostering of our technical and textile schools and colleges, and the encouraging in every way possible the boys and young men in our factories, giving to them opportunities for study and investigation, not only in the line of cotton manufacturing, but also in the different branches of mathematics and engineering.

I do also recommend that the policy already inaugurated by former governors of this Association be approved and encouraged, and that we may have as a part of our records many papers and discussions upon the engineering side of cotton manufacturing.

Why should we not consider and discuss the handling of coal, the operations in the boiler house, the boiler itself, the steam

engine, the belts and ropes which transmit the power, the electric generator and motor, the best forms of construction, the best methods of ventilation, etc.? Is there any class of men on the face of the earth who have more to do with these things, and who ought rightly to know more about them?

Let us then abolish entirely the old idea that a cotton manufacturer is a "spinner of cotton" only, for it has come to pass that to do his whole duty he must be everything, even to judge advocate.

This Association is in a most sound and excellent condition, and is certainly worthy of strong and aggressive assistance, if I may use the expression, from each and every member in every thing.

We must be proud of our Association, proud that we are cotton manufacturers and members of one of the best and most powerful manufacturing associations in the world, and, as such, we must make our influence felt.

The interesting and beneficial meetings are the ones full of discussions.

The value of a paper, no matter how well written, often lies in the discussion which follows.

I am heartily in favor of the presentation of papers by titles or in the abstract, giving in this way more time for the discussions.

Gentlemen, I regret that I am unable to congratulate all of you, or congratulate you as a body, upon a profitable and satisfactory business for the year just past, but I can and do congratulate you upon the courage you have displayed and the glorious effort you have made to stem the ebbing tide, and hold yourselves in position to take ready advantage of the good times which are soon to come, when the American manufacturer will obtain for himself his just share of the mighty markets of the world.

Gentlemen of the Association and friends, no word of mine at this time can add to the heartfelt tribute which this nation has paid to him, who so short a time ago on this very spot, this

Fairy City which we are about to visit, fell at the hands of the miserable creature for whom the word "assassin" is much too pure and too honorable.

That his people loved and admired him, and that they trusted him and leaned upon him, was made manifest not so much by the outward expressions as by the silence and the deep sorrow which pervaded every home in the land, while reverently and tenderly they bore him from this, the scene of his martyrdom, to his old Ohio home. And although time tempers the poignancy of our grief, the memory of President McKINLEY will always be toned with sadness, while the story of his pure and noble life and his heartrending and untimely death has become a chapter in the history of our country, to be handed down from generation to generation, never to be forgotten as long as this world may last.

Less than a year ago, we as guests honored by a special invitation visited his official home and felt the pressure of his hand. Tomorrow we visit the spot where he was so foully murdered.

Would that we had a law so just that to such creatures, be they anarchists or be they not, a law so just that the whole world will shudder at their swift and terrible end, while their names, like their miserable remains, be flung forever into oblivion!

I thank you for your kind attention and wish for you all a most pleasant and most profitable meeting.

The following papers were read:

The Manufacturing Industries: Their Relations to National Position and Progress.

ROBERT H. THURSTON, A. M., I.L. D., Dean of Sibley College, Cornell University, Ithaca, N. Y.

The Past, Present and Future of the Cotton Industry in Japan.

HACHIRO H. FUKUHARA, Tokio, Japan.

The Plant of the Niagara Falls Power Company.
(Illustrated by lantern slides.)

PHILLIP P. BARTON, Niagara Falls, N. Y.

Shortly after eleven o'clock the session was adjourned and cars were taken for the power plant of the Niagara Falls Power Company, which the members and friends were given an opportunity to visit.

SECOND SESSION.

WEDNESDAY EVENING, SEPTEMBER 26, 1901.

Meeting called to order in the parlor of the International Hotel at 8.30 P. M., the President in the chair.

The following papers were read:

The Cotton Fibre in Some of Its Phases.
HENRY G. KITTREDGE, Boston, Mass.

Discussed by Messrs. CHARLES H. FISH, J. R. MONTGOMERY and JOHN MADDOCKS of Bradford, Eng.

The Round Bale at the Mill.
W. S. SOUTHWORTH, Lowell, Mass.

Discussed by Messrs. OSCAR B. TRUESDELL, JOHN E. PREST, CHARLES H. FISH, JOEL SMITH, J. R. MONTGOMERY and J. C. SMITH.

Overworking of Cotton in the Card Room.
EDWARD W. THOMAS, West Durham, N. C.

Discussed by Messrs. JOHN E. PREST, CHARLES H. FISH and C. J. H. WOODBURY.

Cotton Waste.
Col. SAMUEL WEBBER, Charlestown, N. H.

Discussed by Mr. CHARLES H. FISH.

THIRD SESSION.

THURSDAY MORNING, SEPTEMBER 26, 1901.

The meeting was called to order at 9 A. M., President FISH in the chair.

The PRESIDENT. Please come to order, gentlemen.

Mr. ARTHUR H. GULLIVER. Mr. President, your Committee on Resolutions would like to present the following in regard to the death of our late President, WILLIAM MCKINLEY:

WHEREAS, we, the members of the New England Cotton Manufacturers' Association, recognizing the high ability and the noble life of our late President, WILLIAM MCKINLEY, express our sense of personal loss in the cruel end of one whose life was devoted to building up our manufacturing industries:

Resolved, That we deplore the unlicensed freedom of belief and action that will allow such a dastardly deed, and that we ask for the passage of such laws as will restrain and control those that profess such iniquitous beliefs.

Resolved, That we tender a personal tribute to his character and his life as a patriot and president, as well as a friend to each and every one whom he met. We can render this to him more gladly after our experience as an Association of his kindness and courtesy.

A. H. GULLIVER,
J. R. MONTGOMERY,
M. F. FOSTER,
Committee.

Mr. D. A. TOMPKINS. Mr. President, I move that the resolutions be adopted and that the same be spread upon the records of the Association.

The motion, being duly seconded, was put to vote and carried unanimously.

The PRESIDENT. By authority from the meeting of yesterday morning in reference to the ELI WHITNEY tablet, I will take the question up again at this time as being, perhaps, the best chance we shall have, and as the matter was left, the resolution which Mr. DRAPER read, and which the chair was to call up for action at discretion, is now before you.

Mr. D. A. TOMPKINS. Mr. President, do I understand that there is a motion before the meeting made by Mr. DRAPER yesterday?

The PRESIDENT. Mr. DRAPER presented the resolution. The motion was made by Mr. HAMLET that its consideration be postponed to the evening meeting, and this motion was amended on motion of Mr. PREST to take it up at the call of the chair.

Mr. D. A. TOMPKINS. May I hear the resolution?

The resolution was read as follows:

Resolved, That this Association cordially approves the proposition to erect a tablet at Rocky Creek, Georgia, in commemoration of the work of ELI WHITNEY in establishing the ginning of American cotton, and refers this matter to the Board of Government, granting authority to solicit subscriptions from the membership to defray the cost, and to take such measures as may be necessary in the construction and preservation of such a tablet under conditions which shall insure its future care.

Mr. D. A. TOMPKINS. Mr. President, I am very heartily in favor of the resolution. I regard it as being very important, however, that in undertaking to pay a just tribute to a man who has done more service to the world, probably, than any other

inventor, the inscription on the tablet shall be so worded that it shall exactly express the facts in the case and represent the truth and nothing more than the truth. What I mean to suggest in respect to that is, that Mr. WHITNEY undoubtedly invented the first gin that was ever made to separate the seed from the cotton. His machine, by its ingenuity and by its results, entitles him to this consideration, and ought to entitle him to a monument in every city in the South near which cotton is grown and in which it is handled. But his machine was at a very early date — two years after its invention — very much improved by a man named HOLMES, who really invented the saw gin as it is used today, based upon Mr. WHITNEY'S patent. He also obtained a patent, both the patents, the one to WHITNEY and the one to HOLMES, being signed by GEORGE WASHINGTON, so it is tolerably sure that there is no conflicting interest between the two. Now, if we keep that matter before us and make that inscription proper, so that it does not, as it were, take away from Mr. HOLMES the credit for what improvements he made, we cannot pay Mr. WHITNEY too high a tribute or do too much for him. With that explanation, I am most heartily in favor of the resolution and will participate in carrying it out with a great deal of pleasure.

The SECRETARY. Mr. President, in answer to the queries of the last speaker, I would say that this question has been before the Board of Government ever since the first proposition by Mr. M. F. FOSTER, and the historical facts from the writings of the last speaker and other sources have been examined and the tentative plan of the present Board of Government contemplates an inscription which certainly avoids giving undue credit, and at the same time gives proper justice.

Mr. D. A. TOMPKINS. It might be well, Mr. President, to have a special committee to look after the matter, with one or two of the members from the South on the committee. It is a subject that is so close to the interests of that section and their

desires that it would seem proper to keep it well balanced, that it might be very desirable to have a committee of five, subordinate to the Board of Government, of course.

The PRESIDENT. Yes, I think that point is well taken, Mr. TOMPKINS.

Mr. D. A. TOMPKINS. I move as an amendment that there be a special committee of five appointed to look after the subject of raising the money for the tablet and for having it properly erected and placed, subject to the direction of the Board of Government.

The PRESIDENT. You do not state how that committee shall be appointed.

Mr. D. A. TOMPKINS. I think the chair might appoint it. I will incorporate that in my motion: a committee of five, to be appointed by the chair, to take especial charge of this matter, subject to the general direction of the Board of Government.

Mr. J. R. MONTGOMERY. I second the motion.

Mr. D. A. TOMPKINS. You can take ample time to make the appointment.

The PRESIDENT. Gentlemen, you hear the motion. It is moved and seconded that a committee of five be appointed by the chair, at his pleasure, to work in connection with or under the instructions of the Board of Government, this committee to attend to the business of the locating and the wording of the tablet which it is proposed to erect to ELI WHITNEY.

Mr. J. R. MONTGOMERY. Mr. President, do I understand this is an amendment to the motion already before the meeting?

Mr. D. A. TOMPKINS. The motion already before the meeting provides that the Board of Government shall undertake this

work. I ask to amend by having it put in the hands of a special committee of five under the direction of the Board of Government.

Mr. J. R. MONTGOMERY. It is offered as an amendment?

Mr. D. A. TOMPKINS. As an amendment.

Mr. J. R. MONTGOMERY. So I understand it.

The amendment was put to vote and carried, and the resolution as amended was thereupon adopted.

The President afterwards appointed as that committee Messrs. M. F. FOSTER, *Chairman*, D. A. TOMPKINS, W. B. SMITH WHALEY, CHARLES H. FISH, and C. J. H. WOODBURY.

The SECRETARY. Mr. President, the photographer wishes to photograph the party on the steps leading from the rear piazza of the hotel to the courtyard, which can be reached by passing out the door at the left of the room, after the adjournment of this session.

The following papers were read:

Thread Boards and Guides.
LEWIS T. HOUGHTON, Worcester, Mass.

Discussed by Messrs. JOHN E. PREST, JOEL SMITH, and P. T. CREED.

Knitting Industry in the United States.
ALBERT DEABILL, Lowell, Mass.

The Evolution of the Slubbing Frame.
FRANK P. BENNETT, JR., Boston, Mass.

FOURTH SESSION.

THURSDAY AFTERNOON, SEPTEMBER 26, 1901.

By invitation of the Pan-American Exposition Company and the Buffalo Merchants' Exchange, a reception was tendered to the members of the Association and their guests at the New York State Building on the Pan-American Exposition grounds at Buffalo at 3 P. M.

The members and guests assembled in the audience hall of the New York State Building at the appointed hour, President FISH in the chair.

The following representatives of the two organizations above named were present:

From the Pan-American Exposition Company: Hon. JOHN G. MILBURN, President, and Messrs. HENRY H. SEYMOUR, ROBERT K. ROOT and W. P. W. POMEROY.

From the Buffalo Merchants' Exchange: OGDEN P. LETCHWORTH, President, CURT M. TREAT, Convention Secretary, F. HOWARD MASON, Assistant Secretary, and Messrs. ROBERT R. HEFFORD, MORRIS BENSON, ALFRED HAINES, J. J. MCWILLIAMS, F. C. M. LAUTZ, V. P. KINNE, W. A. JOYCE, A. R. JAMES and GEORGE W. FARNHAM.

The PRESIDENT. Gentlemen of the New England Cotton Manufacturers' Association and friends, we have assembled here upon the very kind invitation of the Pan-American officials and

the Buffalo Merchants' Exchange, and it gives me great pleasure to say to you that we are especially honored by the presence of members of the executive boards of both these organizations, and special pleasure when I say to you that Mr. MILBURN, the president of the Pan-American, is here with us and is to address you with a few words of welcome. I now have the pleasure of introducing Mr. MILBURN. [Applause.]

Hon. JOHN G. MILBURN. Mr. President FISH, Ladies and Gentlemen, this is a beautiful day, and I know that with good New England common sense you would much prefer to be enjoying the sights and scenes of the Exposition than to listen to a speech from me or any one else. In fact, when I came here this afternoon it was not with the idea of making a speech at all, but simply to join with the representatives of our Board of Trade, headed by Mr. LETCHWORTH, their president, in meeting the members of this interesting and distinguished body. I think, therefore, on that ground and on other grounds which I need not mention, you will not deem me unmindful of the real demands of the occasion if I do not say any more to you than that we are heartily glad to see you here today, — that it is a great pleasure to us to meet you on the grounds of the Exposition. It is particularly gratifying to find you assembled in a building which is to be a permanent memorial of the Exposition, because this building is a permanent building, and is to be, when the Exposition closes, turned over to our local Historical Society for its purposes. Moreover it is a building which has an especial association of its own by reason of the fact that it is hallowed as the place of the last public appearance under happy circumstances of our lamented and beloved President, who met so terrible a death on these grounds.

I know of no body of men to whom I could appeal more confidently for a real and profound appreciation of the aims and purposes of this Exposition. I want you all to feel that the Exposition is not merely a creation to occupy public attention for some six months as a scene of entertainment, instruction and

amusement and then fade away; but that it was designed for a real and permanent purpose which you as a manufacturing association have at heart, and which we all as American citizens should have at heart. Here are these great American continents consisting of numerous nations and peoples who have never known each other as they should know each other, who have never studied the resources of each other as they should have been studied, and who have never been brought into those social and commercial relations which should have existed between them. The Exposition was based on the idea of bringing them together, and it has been keep true to it from the beginning to the end. And I can say to you with the certainty of knowledge, that it has accomplished that purpose far beyond our expectations, and that the Exposition, looked at from the point of view of its real intention, is a greater success than we ever anticipated. There are here represented in the buildings and exhibits, the peoples of North, South and Central America; and what has been accomplished is to make this country better known to them, this country and all of its resources and capacities, and to make those countries better known to us. This closer relationship was brought home to me most forcibly when around my own table a short time ago I had, besides Buffalo business men, the leading representative from Cuba, from Chili, from the Argentine, and from other South American countries; and there we met and talked as if we all had the same interests at heart and stake, and felt ourselves to be members of a greater brotherhood than any one nation on the continents represents. Therefore I am glad to take this opportunity of expressing the feeling on my part of what has been accomplished by this Exposition, and I am particularly glad to have this opportunity of expressing it before such a representative body as this, because I want you to realize and appreciate that a large good has been accomplished for the trade and commerce of this country by this Exposition as well as the exhibit it has made of our own resources, and what can be accomplished in the way of a beautiful exposition by the genius of American art and architecture.

Now I have done what I did not intend to do — I find myself making a speech; and so, remembering my opening remark, I apologize to you for having done so, and close with wishing you all a happy time whilst you are here, and with the hope that you will take away only pleasant memories of the Exposition. [Prolonged applause.]

The PRESIDENT. Ladies and gentlemen, we will now adjourn, and Mr. MILBURN, President of the Pan-American Exposition, and Mr. LETCHWORTH, the President of the Buffalo Merchants' Exchange, with their associates, will be much pleased to meet the members of the New England Cotton Manufacturers' Association and the ladies also.

An informal reception followed, the members and guests being presented by the Secretary to Mr. MILBURN and by President FISH to Mr. LETCHWORTH and his associates.

Mr. WILLIAM I. BUCHANAN, Director General, expected to be present, but was prevented by business of the Exposition at the last moment, and sent his private secretary with his regrets.

FIFTH SESSION.

THURSDAY EVENING, SEPTEMBER 26, 1901.

Meeting called to order in the parlor of the International Hotel at 9 P. M., the President in the chair.

The PRESIDENT. Gentlemen, please come to order. In opening our fifth session I wish to call attention to a letter which I have received from Mr. WILLIAM FIRTH, a member of the Association. The Secretary will read the letter.

The Secretary read the following letter:

INTERNATIONAL HOTEL,
NIAGARA FALLS, N. Y., September 26, 1901.

DEAR MR. FISH: —

I was very much impressed with your address yesterday to the New England Cotton Manufacturers' Association, especially with that part of your address which referred to the technical education of our boys.

America, now that she is in a position to largely supply her own wants, must look to other countries for an outlet for her surplus production, and to do this profitably must follow the advice and recommendation made by you.

Knowing this, I beg to say that as a mark of my appreciation for the encouragement, and as an expression of my thanks for the many kindnesses received from the members of the Association, I should be

pleased to purchase a scholarship in one of our textile schools and present the same to the Association.

The scholarship to be used for the benefit of the education of a son of a member or late active member of the Association. The use of the same to be in the hands of the Board of Government for the time being, details of which can he arranged later if my offer is accepted by the Association.

With best wishes, I remain,

Yours truly,

W. FIRTH.

CHARLES H. FISH, ESQ.,
President New England Cotton Manufacturers' Association.

The PRESIDENT. You have heard the letter, gentlemen. I wish to say that personally I appreciate this letter very highly. The Association will also feel justly proud that it has among its members such a public spirited gentleman as Mr. FIRTH has shown himself to be. It is without doubt a step in the right direction, and it would seem that the Association ought to avail itself of this generous offer.

Mr. D. A. TOMPKINS. Mr. President, I move that Mr. FIRTH'S offer be accepted and the thanks and congratulations of the Association extended to him for his liberality and forethought.

The motion was seconded and carried unanimously.

The PRESIDENT. The next in order is the election of new members.

The SECRETARY. The Board of Government report with their approval, the following applications for membership:

FOR HONORARY MEMBERSHIP.

HENRY SMITH PRITCHETT, Ph.D., LL.D., President Massachusetts Institute of Technology, Boston, Mass.

Presented by the Board of Government.

FOR ACTIVE MEMBERSHIP.

FREDERICK K. ALLEN, Proprietor Megunticook Mills, Camden, Me.
By Mr. P. T. CREED.

SAMUEL A. CARTER, Pres. Gate City Cotton Mills, Atlanta, Ga.
By Mr. EDWARD C. BEACH.

SIDNEY COOLIDGE, Treas. Stark Mills, 50 State St., Room 17, Boston, Mass.
By Mr. ARTHUR H. LOWE.

BENJAMIN M. EARLE, Prop. Merchants Dye Works, Walnut Hill, Mass.
By Mr. GEORGE E. SPOFFORD.

WILLIAM HALLIWELL, Supt. Lawton Spinning Co., Woonsocket, R. I.
By Mr. E. A. THISSELL.

A. G. HARRIS, Supt. W. H. Draper & Son, 10 Third St., Upper Troy, N. Y.
By Mr. A. E. ADAMS.

SCOTT MAXWELL, Supt. Lanett Mills, West Point, Ga.
By Mr. FRANK B. COMINS.

ROBERT G. MCMEEHAN, Supt. Hamlet Textile Co., Woonsocket, R. I.
By Mr. GEORGE E. SPOFFORD.

E. P. MORTON, Agt. Stevens Linen Works, Webster, Mass.
By Mr. L. E. BARNES.

ALBERT W. NOONE, Prop. and Mgr. Jos. Noone's Sons' Co., Peterboro, N. H.
By Mr. ARNOLD B. SANFORD.

B. L. STOWE, Vice-Pres. and Factory Mgr. Eureka Fire Hose Co., Wilkinson and Arlington Ave., Jersey City, N. J.
By Mr. C. H. FISH.

S. WILLARD THAYER, Treas. Dexter Yarn Co., Pawtucket, R. I.
By Mr. C. H. FISH.

FOR ASSOCIATE MEMBERSHIP.

ALBERT C. CASE, Pres. The American Cotton Co., 25 Broad St., New York.
By Mr. D. C. BALL.

E. W. DAVENPORT, Supt. Crompton & Knowles Loom Works, Providence, R. I.
By Mr. GEORGE W. STAFFORD.

LEWIS T. HOUGHTON, Mfr. Thread Guides, 997 Main St., Worcester, Mass.
By Mr. STEPHEN C. LOWE.

A. H. HOWARD, Pres., Treas. and Gen. Mgr. Howard Bros. Card Clothing Co., P. O. Box 54, Worcester, Mass.
By Mr. A. E. ADAMS.

LAWRENCE M. KEELER, Whitin Machine Works, Whitinsville, Mass.
By Mr. G. MARSTON WHITIN.

FAY H. MARTIN, Prop. The Dunn Flyer, Hyde Park, Mass.
By Mr. T. B. STEVENSON.

The PRESIDENT. I will appoint Mr. WOODBURY, the Secretary, as a committee to distribute, collect, assort and count the ballots.

The Secretary proceeded to the discharge of his duty, and the ballot being taken,—

The SECRETARY. Mr. President, I declare that all of the ballots have been cast without amendment.

The PRESIDENT. I declare that the persons whose names appear upon the ballot have been unanimously elected to the several classes of membership.

The following papers were read:

Steel Forgings for Factory Engines. (Illustrated by lantern slides.)
H. F. J. PORTER, 100 Broadway, New York City.

Discussed by Messrs. CHARLES H. FISH and D. A. TOMPKINS.

Early Southern Cotton Mills.
D. A. TOMPKINS, Charlotte, N. C.

The Possibilities of Trade Expansion in Cotton Manufactures.
WILLIAM WHITTAM, JR., Knoxville, Tenn.

Modern Boiler Problems.
Col. E. D. MEIER, 11 Broadway, New York City.

Discussed by Messrs. F. W. DEAN and CHARLES H. FISH.

The PRESIDENT. Gentlemen, the hour is late; is there any further business?

Mr. JOEL SMITH. I move that the Secretary of this Association be instructed to extend our thanks to all those persons from whom we have received favors during this convention.

The motion was put to vote and carried unanimously.

The PRESIDENT. In closing, I wish to congratulate the Association on the very valuable papers which have been presented at this meeting, and also to congratulate them on the good weather, and the good time I hope that all have had. I now declare the meeting adjourned *sine die*.

Adjourned.

Attest:

C. J. H. WOODBURY,
Secretary.

TRANSACTIONS.

FIRST SESSION.

WEDNESDAY MORNING, SEPTEMBER 25, 1901.

The Association met in the International Theatre, Niagara Falls, at 9 A. M., President FISH in the chair.

The PRESIDENT. The first paper which we have on the programme this morning is on The Manufacturing Industries: Their Relations to National Position and Progress. It gives me great pleasure to introduce to you Dr. ROBERT H. THURSTON of Cornell University. Dr. THURSTON, it is unnecessary for me to say, is one of the best known professors in this country and a man of whom we have all heard many times. Personally I have taken more pleasure in listening to Dr. THURSTON'S papers than any one's else that I can think of. [Applause.]

Dr. ROBERT H. THURSTON. Mr. President and gentlemen, it is my first duty to thank the officers and members of this Association for their kindness in inviting me to be present on this occasion, and especially to come as their guest. But I am happy in feeling that I have some claim to be considered at

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least as affiliated to the membership of this Association. A half century ago or so I was very familiar with the cotton industry. I visited with my father, who was then a manufacturer of steam engines and machinery and had much to do with the cotton mills of New England, about every cotton mill in the State of Rhode Island and a large proportion of those in the State of Massachusetts, and my favorite entertainment when a child was, on holidays, vacations and Saturdays, to make visits with my father among the mills where he was conducting repairs or where he was setting up the steam engines he was then building. He himself was intensely interested in the work. He was a personal friend of SAMUEL SLATER and his family, and of AMASA SPRAGUE of Rhode Island, the pioneers in that industry in that state. And I myself was personally acquainted in those days with the then younger generation, and no part of my early life was more instructive and no reminiscences have been more interesting to me, than those of the days that I spent in that manner with my father in inspecting the cotton mills of New England.

While circumstances have been such, since, as to throw me entirely out of that line of work, and I have only been able to keep track of it by reading and by occasionally meeting the gentlemen who are in the business, yet I have always read the proceedings of the Association with particular interest. I have a file of the Transactions, which I believe to be complete, and I consider that one of the most valuable portions of my library.

In speaking to you this morning my object is to offer to you a discussion, as the title indicates, of the relations of the manufacturing industries of the world to national position and progress. It seemed to me that in coming before the Association this morning with the leading paper of the session, it might be wise to make a discussion of this broader view of our interests and economics, and to give some consideration to those broader matters which control those industries and the great interests of the country at large; to show, if I could, some of the relationships between the industries of the country and the

prosperity of the people, the character of growth of industry, the character of methods of its stimulation, and the relation of such methods, as far as successful, to the promotion of the great interests of the country in the broadest sense.

THE MANUFACTURING INDUSTRIES: THEIR RELATIONS TO NATIONAL POSITION AND PROGRESS.

ROBERT H. THURSTON, LL.D., Dr. Eng., Director of Sibley College, Cornell University.

A retrospect of the XIXth Century and a study of the industrial progress of the nations during that period and of the situation today is sufficient to convince any intelligent and unprejudiced mind of the fact that advancement in civilization depends upon progress in the industries of the people. While civilization and general intelligence may, as in Greece in classic times, pervade an aristocratic class, and while comfort and luxuries may at any time be secured by the rich, it is only when our manufacturing industries — and the agricultural industries and those of mining, in fact all productive industries, are falling into that category — it is only when our industries are prosperous and productive and when, therefore, the people may in maximum degree share the comforts and luxuries with the rich, that national progress can be assured. Substantially all of the extraordinary progress of our country and of the civilized world which has been witnessed during the last century, and particularly since the revival of industries about 1870, has been affected through the promotion of improved methods, the adoption of scientific systems and the introduction of universal and cheap intercommunication and transportation.

The great economic question of every nation and of all times to come is now clearly seen to be: How shall the industries be most effectively sustained and promoted as a basis for all moral, intellectual and material advancement hereafter? The answer

is coming to be no less well and definitely determined: Industry scientifically utilized is the needful thing.

The XIXth Century may well be called by WALLACE "The Wonderful Century" and not the least among its uncounted wonders have been "The Wonders of Modern Mechanism"; for our mechanism is mainly the product of the century just closed. The progress of invention in the XIXth Century has been one of the marvels of history; though we may well believe it to be a marvel likely to be eclipsed in the centuries to come.* It has been a century of wealth and progress beyond all anticipation or example, and of wealth and progress, not in material things alone, but in all that makes life—moral, intellectual and spiritual. The history of the movements of life and of morals, if another LECKY could write it up to date, would show no less impressive a growth in quality and quantity than that of the progress of the currents of tangible wealth. The century has been one of expansion of industries and of growth in education of the people, of development of wealth of nations and of comfort for the individual, of good habits and good feeling, of intelligence and wisdom for the average citizen and in all ranks of life and all departments of exertion.

The foundation of the whole marvellous advance of the last generation and of the less remarkable, but still impressive, advances of the earlier decades of the century, was laid when the inventors of the steam-engine and of the spinning frame and the power-loom, of the whole modern system of textile manufactures, in fact, made it possible to effectively utilize the powers of nature and the skill and intelligence of man, in conjunction, in the construction of a national system of manufacturers, thus giving a single worker ability to produce as much, in these later years, as then could a score.

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*The Wonderful Century; ALFRED RUSSELL WALLACE; N. Y., Dodd, Mead & Co., 1899.

The Wonders of Modern Mechanism; CHARLES H. COCHRANE; Phila., J. B. Lippincott Co., 1900.

Progress of Invention in the Nineteenth Century; E. W. BYRNE; Munn & Co., 1900.

The chronology of invention in the XIXth Century would alone make a volume; but the merest outline will suffice to enable one, however unfamiliar, to realize the indebtedness of the XXth Century to the XIXth.*

My father was born in the year 1800. He saw the Volta battery developed, and the Roberts paper-making machine (1800); the one to initiate the era of electrical distribution of energy, the other to inaugurate even higher development — that of perfecting a means of distribution of intelligence throughout the world by books and the newspapers. RUMFORD and DAVY were then introducing to the world of science the notions of the "Law of Substance" and the equivalence of the energies and proving the doctrine by experimental illustration of thermo-dynamic transformations. WATT was perfecting the Newcomen engine, and the young man of twenty-one, two years after WATT'S death (1821), built, with hammer and chisel and file and foot-lathe — without any of the modern conveniences for such work — an engine illustrating WATT'S construction, adding a little later, the water-tube boiler (1827) in the form known as the "pipe boiler," a device original with him, but not new, even then. The day of the steamboat and of the steamship began at the end of the XVIIIth Century and this XIXth Century engineer saw its full development to substantially its present form and almost to its present extent, mechanically.

The Jaquard loom appeared when he was one year old (1801); TREVITHICK'S steam coach, the first at all successful automobile, was completed in the same year; FULTON'S steamboat made its successful run to Albany, inaugurating commercially and permanently successful steam navigation, when he was seven years old (1807) and after he had seen FITCH and EVANS and STEVENS and MILLER and SYMMINGTON and others just fail of such success. SAMUEL SLATER who founded the cotton manufacturing industry of our country (1806) was, later, his personal

* See "The Progress of Invention in the XIXth Century" by E. W. BYRNE, N. Y., Munn & Co., 1900. Also Machinery, December, 1900, p. 115.

friend and all the pioneers in these fields at the time were known to him. He saw the compound steam-engine introduced and reintroduced and finally made standard. He sustained STEVENS and others in their efforts to secure the introduction of the railroad and the locomotive and saw every advance from the experimental work of HORATIO ALLEN, following GEORGE STEPHENSON to the splendid development of the great trunk-lines of the United States.

He saw the inception of the arc lamp, from its discovery as an arc by DAVY to its installation as a matter of business by the later inventors. He saw the rise and progress of the telegraph. He saw FULTON'S first of all protected steam battle-ships, the "Demologos," and he saw an iron-clad fleet. The arts of DAGUERRE and of photography were developments of his early manhood and middle life. He watched the voyages of the "Savannah," the first transoceanic steam-packet, and saw the growth of the Cunard line and worked for its contemporaries. He was familiar with the work of FARADAY, the founder of modern electro-dynamics. Friction matches astonished him in 1827 while making a trial trip of one of the steamboats built by himself and JOHN BABCOCK as a very rash and unpromising experiment. His friends thought it illustrated too rash a practice, with its "safety" boiler and high steam-pressure.

He saw the introduction of NEILSON'S hot blast for melting iron in the blast-furnace and thus enormously accelerating the production of cast iron (1828). He was still a young man when the reaper and the mower were invented and our great Western wheat-fields were thus made cultivable for the benefit of the world. BURDEN, the inventor of the horse-shoe making machine, and Col. COLT, the maker of the revolver, were contemporaries and friends. JACOBI'S electric boat and his electric locomotive were among the interesting inventions appearing when he was approaching forty and in the year of the birth of his oldest son; whose portrait might, in that year, have been taken by Draper & Morse, the first photographers (1839). He marvelled at the first telegraph message sent over the Morse

line between Baltimore and Washington and his son now has in his collections the instrument which received the words "What hath God wrought"! He was familiar with the construction of the Howe Printing Telegraph Instrument and was equally familiar with the Howe and later sewing machines, the Hoe press and the Sloan gimlet-pointed screw and knew their inventors.

He was the builder of the Sickels cut-off for steam-engines, the first device (1841) to successfully illustrate the principle of WATT in the expansion of steam. CORLISS was his rival (1849) and GREENE (1855) his coadjutor in a long and costly strife for the control of this valuable element of modern steam-engine construction. Gun-cotton, nitro-glycerine and dynamite, the breech-loading gun and all modern high explosives, and the arms with which they are utilized and the armors with which they are defied, were the work of development of his century. He watched the evolution of the steel-making processes of BESSEMER (1855) and of SIEMENS (1856-65) and his son knew and did business with both, during their period of evolution of modern steel manufactures, their introduction of the Steel Age as the successor of the now expiring Iron Age. The laying of the Atlantic cable, the binding of the nations together by the electric wire (1858) impressed him as they could impress no one who has since come into a world in which these are now commonplaces.

Coal-oil, natural gas, mineral illuminating oils, lubricating oils and all the floods of petroleum products and by-products came to astonish him when passing out of middle life (1859 and later). Calcium carbide was made by WOHLER in his time (1861) and the first passenger elevator of OTIS was produced in the same year. The Timby iron-clad revolving turret (1843) on JOHN ERRICSON'S iron-clad, the "Monitor" saved a fleet, and perhaps a nation, a year later (1862) and he witnessed the whole enormous military and naval evolution, reducing both branches to one common profession, that of mechanical engineering, as the outcome of that great civil war. The complete introduction of

breech-loading fire-arms and heavy ordnance, revolving and repeating guns; the telegraph and the railroad and the war balloon as adjuncts of military and naval operations; the iron-clad becoming established as the only war-vessel of which to compose a fleet; the torpedo and the torpedo-boat becoming firmly engrafted upon the organization; the mechanical engineer becoming the fundamental element of the personnel and the iron-clad becoming his war-engine:* these are some of the changes seen in his day.

The following years were those of development of the dynamo-electric machine and of electric transmission of power and the machines of WILDE, SIEMENS and GRAMME then initiated modern practice in that field and paved the way for entrance upon the scene of the "electrical engineer" as one of the many specialists in mechanical engineering. The 71st year of our witness of these modern wonders saw the Hoe "Web Perfecting Press," the grain-binder and the rock-drill introduced; the next year the air-brake and the year of his death (1874), the duplex and the quadruplex telegraphs became known and practically operative.

Since his day we have nearly all of us seen the progress of mechanical engineering to the end of the XIX Century: refrigerating and ice-making machines, (1875), "roller-mills" for flour-making, (1875), the telephone, (1876), the phonograph, (1877), the electric lamp with its incandescent filament, (1877); each revolutionizing an industry: the introduction of the typewriter (1878) effecting as complete a revolution in methods of doing business; the street electric railway and the electric locomotive (1879) for heavy work, giving freedom to the then suffocating dweller in cities, now permitted to live in the country and have his garden and his dairy, while working in the city, or he can live miles from his sphere of employment in the great city, if so disposed and if it proves more satisfactory so to do.

The steam-turbine (1884) has been revived, after two thou-

* "The Engineer and his War-Engine." R. H. T., N. A. Rev., 1898.

sand years of quiescence since HERO first described it, and threatens possibly to drive out of use the wonderful products of the ingenuity of WATT and SICKELS and CORLISS, the products of work of the greatest of the inventors of the XIXth century. The "linotype" has enabled the mechanic to produce a new form of stereotype in multiplied quantity in the limited time given him by the machine-made newspaper.

The industrial world is one in which the human hand and brain, working to a common end, find ingenious mechanical combinations and discover new methods by which the labor-assisting machine may be made to do the work of the world, more and more completely, and thus reduce the time and lighten the labor of the people while permitting the rapid accumulation of wealth in forms of permanent value. The world of agriculture is coming to be a world of mechanics and its people are more and more segregating where they find life most attractive and are finding, more and more generally, ways of securing, for themselves and their children, comfort, competence, education, freedom from anxiety, certainty of ample reward for lives of industry, ambition, frugality and of intelligent use of their physical and mental powers.

One impressive aspect of the industrial changes of the century just expired is the tendency of all departments of industry to become systematized, to take on organization and especially to secure the aid of labor-assisting machinery, becoming branches of mechanical engineering.

Thus: farming became, in the later years of the XIXth Century, systematic and scientific agriculture and is now conducted in all its larger details by machinery. Ploughing, sowing, reaping, binding, threshing, grinding the grain, taking it to market, transporting it to city or distant country and across the ocean to feed other nations: all is done, today, by machinery and this branch of mechanical engineering now equalizes the distribution of the food of the world, sends the surplus of one district to the starving people of another in which crops have failed, and

permits a world-wide system of constant adjustment of supply to demand.

Meat-production is similarly made an industry in itself and the cattle of a thousand hills and of all the great Western and Southern plains are gathered together by the machinery of transportation and passed through a great system of machinery of transformation, at Chicago, for example, in numbers equivalent, each day, to those of a marching army filling the highway for miles. A single one of these great factories annually converts about five millions of swine, two millions of cattle, and a million of sheep into food; employing over ten thousand people, in fifty acres of buildings, its business amounting to a hundred millions of dollars annually, or more.

Cotton, wool, flax and silk, all textile processes, have come to be materials and methods of mechanical engineering. Mills containing a hundred thousand spindles are furnished with steam engines of four thousand horse power and upward, distributing power to all departments, from pickers and carding machines to spindle and loom, through electric wires, retransforming it at the distant point of application by electric motors and driving thus, every machine at its proper speed and with necessary force, throughout acres of floor, reinforcing the minds and hands of the thousands of operatives gathered together to apply their thus many-times multiplied powers to the correspondingly multiplied advantage of their fellows and themselves. The textile factory is a great machine and the most impressive illustration, perhaps, of our time, of this tendency to convert all industries into branches of mechanical engineering.

Metallurgy almost as strikingly illustrates the same evolution. Iron ore, for example, is now taken from its bed by steam shovels, loaded into ore trains, transported by steam to tide-water, and transferred to the hold of a steam vessel of thousands of tons capacity, specially adapted in construction to this purpose; transfer being effected by powerful and largely automatic machinery. It is then transported by ship and by train to the iron works where it is once again transferred by machinery to

stock house or to blast furnace and converted into molten cast iron; this run out of the furnace, flows into a steadily moving series of moulds in the "casting machine", cools as it travels towards its destination and is finally deposited in neat and compact layers and rows in the stock yard. Machinery later transports it to the steel making and rolling mills; machinery drives the mechanisms of the converter and the apparatus of the open-hearth furnace; machinery transfers the product, as steel, into the ingot moulds and from the moulds to the mills. Steam power of enormous quantity compresses and forms and shapes to guage the hot, soft mass and passes the piece from roll to roll and from point to point in the mill until it appears, ready for the market, as rail, beam, bar or wire; machinery doing the work and the hand and brain of man simply guiding the unconscious product and servant of the human mind, from beginning to end. Sent into the market, the various shapes are taken into other mills and factories and there, by other mechanical engineering systems, are converted into new and useful forms, aggregated into machines, tools, and motors capable of driving all other machines and tools, and a cycle is completed. The inventions of CORT, of DUDLEY, of BESSEMER and of SIEMENS were never capable of complete development until incorporated into this great system of world-sustaining engineering.

And thus, in every department, it might be shown that a distinguishing feature of the XIXth Century has been this evolution of divisions of mechanical engineering out of old hand-industries and the incorporation of all new inventions into the steadily evolving and expanding world-wide organization of mechanical industries. The guiding head and hand of the inventor and the mechanic are now coming to be combined in the person of the scientifically and professionally trained mechanical engineer, the man competent to devise a mechanical means to every prescribed end and to scientifically design where the cruder man "invented". To all this, the pioneer work of the early organizers of the textile industries was introductory in the earlier half of the XIXth Century and the later developments, effected by some of our

own contemporaries, has been along the lines laid down by those great builders of a nation.

Not the least significant and promising and, in fact, fruitful of the innovations of the century was that of the education of the people for the life and work of the people, especially as illustrated by Germany. It was Germany that most clearly and unmistakably gave answer to our greatest of economic questions in the early part of the century, when Prussia inaugurated her system of industrial schools and technical education, building up the whole range from the kindergarten to the technical university while other nations were dreaming along in the old educational ruts. Germany was, to be sure, driven to innovation by necessity, and saw in this modern system of preparation of her people for their work the only way to counterbalance her disadvantage in the struggle with the pioneers in invention, the nations of mechanics and politically free men, yet her credit and her profit, will be none the less — indeed, it is the greater.

As I have taken occasion to state elsewhere*: "The ultimate cause of these developments of the United States which have so astonished the world is that perfect freedom, political and conventional, that freedom of the individual to mark out his own life and strive for his own highest goals, unhampered by governmental dictation or by bonds of caste, which has given the American citizen hope, ambition, purpose and effective energy. It is this which gave him invention, power of achievement, his patent laws, his legislation in behalf of essential industries, even his alert mind and his patriotism and love of country. It is this which has given us our common schools, which has promoted the organization of schools of the arts and trades and productive professions and the whole system of technical education and of industrially applied science. This has given our capitalist a new use for accumulated wealth in the endowment of schools of science and the promotion of education generally, has induced the adoption of organized industrial systems on such an enor-

* Science; April 19th, 1901; p. 631.

mous scale and has permitted the introduction of labor-assisting machinery without serious opposition on the part of those certain to be ultimately most benefited by the resultant increase of wages and decreased costs of product."

Education has made great advances in our country, even though hardly comparable, in industrial education, with Germany. Our splendid system of common schools and our widely spread opportunities for higher education give us good reason for satisfaction and patriotic pride. The opportunity offered in this country, as in no other, for the poorest boy to find his way "from the gutter to the university," as HUXLEY phrased it, is one of our most beautiful and helpful national advantages, giving opportunity to men of genius to rise out of every rank and from among all classes.

A generation ago, 1871, when I first undertook the work of training engineers scientifically for the industrial vocations and especially the manufacturing industries, it was difficult to secure from the employer the slightest consideration for the educated professional; while the so-called "practical man" was attempting to lead, as general, the industrial armies of the nation. Today, the industries of the country are being rapidly transferred to the direction of the technically educated leader, the product of the work of the science-teacher and the engineering school. With a thousand passing out into business each year, the demand still exceeds the supply and the leading schools and colleges of engineering are compelled to reply to the applications of the manufacturer, or other proposing employer, "Not a man unengaged." Educated men, once abused as conceited, helpless, and useless, are now found to be precisely the men for the work and the now efficient training in shops and laboratories, supplementing their general education and scientific acquirements, is discovered to be exactly adapted to their advance from the ranks to the position of commanding officer in any department. As I have elsewhere said:* "Another generation will see the whole in-

* London Engineering; Mch. 30, 1900.

dustrial system of the United States practically under the hands and direction of these technically trained men."

"All the great corporations engaged in manufacturing are falling under the supervision and are subject to the energetic and discreet management of these young men, trained in the sciences as well as the arts of their chosen vocation. The extent to which this change has taken place is a matter of astonishment to all familiar with the fact, but unfamiliar with the enormous difference in value between the so-called 'practical' man without scientific knowledge and the young professionally trained engineer, well educated, familiar alike with the facts and the reasons for them, and capable of making himself 'practical' in a wonderfully short time, then constituting the ideal 'captain of industry.' The great successes in this department of life in the United States are of young men of this class. Fighting their way into the superintendencies of shops, mills, factories, railways, and great manufacturing industries, they are rapidly proving the value of a combination of scientific knowledge with talent and practical experience. They are a selected class; for every man of them, in the case at least of the great schools of engineering, must have secured his admission by meeting entrance requirements that the average youth can rarely attain, even if — as all these young men must be, to succeed — naturally fitted for the professional work of the school. This includes, usually, shop-work, drawing, designing, chemical, physical, mechanical, electrical engineering, laboratory work, often serious research supplementing instruction. The student's fingers and brain are alike cultivated, through four years of the most arduous work known in our colleges, in even the professional schools."

"It may not be the fact that our technical schools have had a very important influence in the past; but they are exerting a wonderfully powerful influence now, and will exert a vastly greater power hereafter in the uplifting of our 'curves of progress'."

How much of the unprecedented growth and social progress of the people during the XIXth century was due to natural

resources, how much to the character of the people themselves and how much to favoring circumstances of other sorts, including a policy of encouragement and stimulation, by legislation, of its manutacturing industries and of its inventive and constructive talent by a patent-code, no one can say. It was apparently as obvious to WASHINGTON and his contemporaries, as to our own statesmen, that the young nation could not become safe and independent until its commercial independence was as positively assured as was its political independence: and it was evident to HAMILTON and other great statesmen of the time that a statecraft which should release the country from the commercial Sindbad which had been riding it all through its colonial days would prove as essential an element of final, complete, independence as was the war policy which shook off the Old Man of the Sea when he had a hardly more vigorous grasp through his governmental control. However all this may be, the new century sees this commercial independence fully attained and, in case of attack from any foreign enemy, however powerful, our country is now as independent industrially as politically and, if completely closed in by enemies, even, can go on indefinitely supplying its people with all that they may need to continue their life and work, precisely as in time of peace. And this commercial independence has been acquired during only a century, three generations of growth with steady progress in all that makes life worth living to a self respecting people, without any apparent loss or sacrifice and with constant relative gain, compared with any other people on the face of the globe. Yet, had it been paid for in sacrifice, financial, social, any other than moral and intellectual, it would have been worth all it could have cost us in the whole XIX century. As it is, we have meantime gained in every way.

Our people have become, in education, general intelligence and fine moral and social quality the superior of any people on either continent. They have also gained inventive talent through the stimulus of the patent-laws, defective as they have been and as, in some respects, they still remain. They

have progressed in social organization, in industrial and commercial efficiency, in every phase of enlightened civilization, including, as its item of minimum value, if you will, mere wealth. But "mere wealth" is the foundation on which is built up all modern progress. Our Pilgrim forefathers brought into the country the right sort of stock of which to build up nations; the early privations and trials of life in a savage country stimulated and ripened that stock; their relations with the Mother Country, trying as they often were and unbearable as they finally became, gave form to a vigorous and intelligent and rarely wise statecraft. That statecraft, founding the state common schools and establishing the constitution, laying down the principles that diversification and promotion of industries of every essential department must reinforce the provision for political independence and that the stimulation of invention was the vital element of progress in every art, consistently and continuously legislating for the best interests of a free and independent people, finally, at the close of its first full century, has brought the United States of North America to the place which it should always hold and relatively advance—that of the foremost nation of the globe.

We are, undoubtedly, threatened on every hand, by jealousy abroad and by demagogueism and its perhaps more vicious twin-demon, amateurism in public service; yet we may take courage from the history of the century and look ahead with full confidence that our case will grow better and our position safer every day, until the demagogue and the self-seeking amateur, in science or in practical life, shall have been completely extinguished and the progress and tendency of every department of life shall be unimpeded towards a higher and still better life.

The development of our manufactures and mechanisms in the electrical industries has been of latest growth. A quarter of a century ago, there was but a bare beginning made in the distribution of energy into electric lighting systems and less than twenty years ago we had no electrical railways in more than experimental operation. The telephone was in its earliest

stages of evolution into exchange systems and even the telegraph only a half century ago passed its doubtful period. Today, we have nearly a hundred millions of dollars invested in the telephone business alone, employing fifteen thousand people on three-quarters of a million miles of line. In the fifteen or twenty years of growth of the street railway, we have built about fifteen thousand miles of line, costing nearly a billion of dollars, and our thousand or more electric light companies have come into existence with five hundred millions invested. Current is transmitted over scores of miles, a hundred and more in some cases, under pressures of forty and fifty thousand volts, from steam engines and from water wheels located ten, twenty a hundred, or a hundred and fifty miles from the point of utilization, in distant mountain gorges or by Niagara's sublime cataract. With its thus lengthened and far-reaching arm, the steam engine or the water wheel sends its transformed energy from its fuel or stream out over the intervening country, lights a city, operates hundreds of miles of railway, supplies power to distant mines, mills and factories, reduces copper and aluminium from their ores by the thousand tons and conveys messages across a continent and under the ocean to another continent. We are now ready to seriously attack the greatest of all physical problems, from the standpoint of the mechanical engineer as well as of the sociologist, that of directly transforming energy potential in our fuels into active and directly useful form, for all these and many other, coming, useful tasks.*

The progress and tendency of higher education in industrial engineering through the XIXth century and into the XXth century will be found, on investigation, to be curiously parallel with the movements of a characteristic material progression representative of the advance of the world during the same period. We have found it to be true that a good gauge of the progress of the nation is its employment of iron; we shall find,

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* The Mechanic Arts and Modern Educations.—R. H. T., Richmond, Va., 1894, W. E. Jones, Publisher.

on comparing the two curves of progress, that the rise and the onward and upward movement of that industry which produces skilled and learned captains of industry has had a method and rate of development in the last generation strikingly similar to that of the iron and steel, or of any other great and fundamental industry. How far this parallelism is an example of cause and effect, or which is the cause or which the effect, or how far both developments are due to a common and deep-lying cause, may be a question in the minds of many; but that this similarity of the two curves of progress exists is simply an obvious and visible fact.*

The earlier stages of this phenomenon are observed all through the early part of the century in our own country, much earlier in France and Germany. The output of the professional engineering schools was then very small and mainly of practitioners in what is distinctively known as civil engineering. The growth about the middle of the century was rapid, presumably largely as a consequence of the exceptional demands and opportunities of railroad building. With the cessation of that for the time abnormal demand and with the stimulus given immediately afterward to our manufacturing industries, the period of evolution of the mechanical engineer arrived and about 1870 the facilities for the commencement of this evolution began to be provided. They were promptly availed of by talented young men of natural proclivity toward mechanical construction and toward invention.

The demagogue who talks out of the abundance of his ignorance and folly and who caters to the ignorance and passion and prejudice of his more modest fellows; the amateur who has the assurance and folly which induces him to accept, or even to seek, positions in which his untrained mind and his lack of knowledge render his every act a menace to the business and to all who have to do with him, the unambitious and sluggish official who blocks the progress that live men would promote:

*London Engineering, March 30, 1900.—R. H. T.

these are all rubbish in the path, rubbish which the coming man must clear away as a part of his task, in politics, in business and in education. The Twentieth Century Man is he who best exemplifies the spirit which is to characterize the best aspects of the coming century. Learning will be needed by him; but learning alone will not make the man. A fine spirit and a wholesome ambition for highest and best fields of labor and for successful work in those fields must stimulate the man; but ambition, lofty as it may be and wholesome and noble as it may be, will not prove the only essential. The Twentieth Century Man must be his best in every part, physical, intellectual, moral, spiritual and in nature and fineness of that ultimate, that innermost spirit which constitutes the mainspring of life.

Learning is desirable and is in fact essential to highest rank among men; it will be still more essential in the coming days. Wisdom is more vitally important than even learning. Culture is a characteristic to be brought into the man's make-up as well as learning and as well as wisdom; but to culture should be superadded, and beneath all, as fundamental, must be laid, the foundation of sound, wholesome, vigorous, healthful, individual *character*. Wisdom and learning, knowledge and culture, all related, all differing, all needed, can only be made effective for the great work of the XXth century through native force and character, cultivated with conscientious care, reinforced by knowledge and refined by wisdom, learning and culture. Meantime, no nobler task is his than that of maintenance of freedom and independence for every man, however humble, however isolated his station.

A plea for freedom should be in the mouth and should appear in every act of every honest, earnest, good citizen. It would be disheartening were we compelled to believe that the "spirit of '76" had vanished from the face of this earth and that the country of Washington and of the Men of Lexington had degenerated so far that any one man had ceased to be free, and absolutely free within the law, or that individual rights were anywhere ignored without a protest, universal, prompt and effective. And

yet it is not certain that this outcome, liberty of the individual degenerating into the license of a mob, is not now threatening; for it is now and then true, to our shame be it spoken, that a citizen of the United States may claim his liberty to adopt any vocation that may best suit him, to make a bargain for his time and talent mutually advantageous to himself and his partner in the contract, and may yet, in the attempt to exercise those fundamental liberties of a free man, be exposed to intimidation, abuse and even to risk of life and fortune.

It begins to look very much as if there might be yet an opportunity for the men of coming days to exhibit that same spirit which distinguished our fathers, a hundred and twenty-five years ago, and, in turn, to vindicate their glorious achievements by standing up once again for personal liberty and the rights of the individual free man. Should this, which we may well hope may prove an avoidable situation, arise, the young man who refuses to work, and if need be, fight for freedom in the new battle for the highest and best that patriotism may aspire to and may rightfully demand, will be recreant to all honor and to all patriotism. He should be branded as a selfish coward and traitor. He will stand at the lowest extreme of the scale on which the patriot and the martyr will stand at the top. Every man should hope and pray that this trial may not come; he should do everything in his power to avert the danger; but, *if it comes*, despite the efforts of all good men and true, he should prepare himself to do knightly service for the right, for home and for country.

The Brotherhood of Man can only be established by the XXth century type of leader. It will be mainly established by the captains of industry, who, leading the great armies of workers, can appreciate, as can no other men, the rights and wrongs, the deserts and the deficiencies, of the individual and of the class. The Brotherhood of Man can only come through intelligent, fair minded, just conduct of the business of life. It will come when every man can feel that his honest effort will be appreciated and will be rewarded fairly in accordance with his

deserts; it will come only when he sees that generous exchange of service is the fundamental element of industrial systems. The leaders of the industrial armies, the leaders in finance, the higher powers of the social world, can best inaugurate these things. It is the systematically trained man who may most confidently aspire to the privilege of wielding these powers and thus of making the path smooth for social regeneration. This is his grandest task as leader.

Such a much-to-be-desired result can never come, however, through the cleverness of man in devising new systems of production. It will not be socialism, nor anarchy, nor any other *ism* that will bring it about. Under whatever system we may inaugurate, so long as man is selfish and self-seeking and uncharitable, the existing wrongs will continue. It is only when the people are led toward right feeling and right action, individually and collectively, that universal peace can come. There can be little doubt that we shall continue to perfect our organizations and our systems of production, that co-operation of employers and of employes will continue, that further improvement in methods and in apparatus and machinery will carry on the evolution that the XIXth century began; but it is not unlikely that employers and employes and capitalists and workers will, in time, co-operate, and that, industrial generals leading, the whole industrial army will be perfected and will be operated by a perfected man, and harmony then reign.

If we accept, as I presume we all may, a definition of ethics given by HERBERT SPENCER, which asserts that it includes the various aspects of conduct which are not only in themselves worthy of commendation or of reprobation but also those which tend to promote such methods of conduct, or the reverse, it must be at once admitted that every phase of the industrial evolution has an ethical bearing and importance. In fact, there is no aspect of the development of the industrial world—which means of the whole social world, evidently—which does not assume ethical value. The promotion of civilization through industrial development and the progress assured through the

aggregation of wealth in the hands of the people of our nation influence the ethical and religious worlds in a vital manner. The universal diffusion of intelligence and of knowledge which can only come with the industrial development of any country is a direct consequence of the evolution of the industrial system of the nation. The progressive rise in the value of the day's work, the synchronous fall in the costs and prices of commodities, the accummulation of wealth in houses and lands and durable articles of comfort, and especially in schools and colleges and churches and benevolent institutions of all kinds, and advancement in all departments of production result invariably in a better state of society, physically, intellectually, morally and spiritually. While this is admittedly an "industrial age," it is, as a direct consequence, an age of intellect and brain, not purely muscular physique. Intellectual vigor, backed by physical power, determines the course of empire in all realms. Minds, not arms, rule the world and more and more as the evolution of the industries and the resultant independence of the individual citizen are perfected. Compare the moral condition of the peoples one, two, three generations, a century, two centuries, ago, with the conditions of today! Freedom has stimulated thought; thought has produced intelligence; intelligence has given us a new social and industrial world and has begotten greater freedom, higher intelligence, better powers of discriminating right and wrong; and the peoples of the world are the better for it all. The once much-berated factory system has proven itself an element of moral as well as physical progress and the displacement of labor by machinery, which has given the hand of the worker multiplied capacity, has been discovered to be a blessing. Relief from the temptations of abject poverty, such relief as machinery has given civilized peoples during the XIXth century, exerts an enormous influence for good, and, while it is true that a vast amount of evil remains, even today, it is none-the-less true that the world is enormously better, and that the residuum of evil is vastly less than before the progress of the inventor, the mechanic and the mechanical engineering of the world had given such effective aid to social advances in all directions.

In proper sequence, a better education, through a common-school system, better fits the individual for life in all departments; a better trade or professional training gives proficiency and an early and efficient preparation for productive work; a life of larger productiveness, with shorter hours of labor, larger returns for the day's work and more discriminating use of earnings: these conspire in insuring a larger and a nobler life to all who choose to take full advantage of the opportunities and blessings thus offered. With doubled wages, prices halved, hours of work reduced a third, during the century just passed, the human life is made five times as desirable as in the days of our grandparents, as measured by simple material standards, and is rendered still better worth living as seen from the point of view of the moralist, the good citizen and the scholar; all of whom occupy the same standpoint. Man is rising to a higher standpoint and to a higher life, in all directions. Ignorance diminishes; poverty relatively lessens; the less intelligent classes in all ways profit by contact with those more intelligent; the work of the well-trained and talented is taken up by the less well-trained and talented. These are bettered by the change; those are given place on a still higher level; segregation of classes or of individuals tends to give improved social conditions on the whole and every such social aggregation is a point of development of higher social and intellectual and moral life.

Thus we have seen our great industrial system of the modern world take form and become systematized, organized, officered with able and wise generals and colonels and captains and lieutenants, with hardly less able and wise non-commissioned officers, leading an increasingly intelligent rank and file; the whole system improving steadily through all the years which have succeeded the days of ARKWRIGHT and WATT and their contemporary pioneers. This progress will undoubtedly go on during the years that are coming, and perfected systems of education and training, of industrial operation and of administration, with unlimited progress through invention and discovery, effected by scientific and learned and practically experienced men, will

continue indefinitely — *provided* wisdom, righteousness, industry, fair-play, and the freedom and independence of every individual citizen, can be assured for all time.

There never was a time when we had better reason to adopt the prayer of our great American poet, WHITTIER:

> Our Fathers' God! from out whose hand
> The centuries fall like grains of sand!
> * * * * *
> O! Make thou us, through centuries long,
> In peace secure, in justice strong;
> Around our gift of freedom draw
> The safeguards of our righteous law;
> And, cast in some diviner mould,
> Let the new cycle shame the old!

The PRESIDENT. You have heard the paper of Dr. THURSTON. If there is nothing to be said and no questions to be asked upon it, we will proceed to the next paper. We have with us a young Japanese student, and if he will excuse me for saying so, a good representation of what the Japanese can do and what the Japanese are doing. This young man came to this country only a short time ago. His experience with the English language covers a period of less than two years. He has written a most wonderful paper, almost without a mistake from beginning to end, a paper which is practical and is technical, and a paper which would do credit to an American engineer, born and brought up in this country. Very few could do what this young student has done with so limited study. I take great pleasure in introducing to you Mr. HACHIRO H. FUKUHARA of Tokio, Japan. [Applause.]

THE PAST, PRESENT AND FUTURE OF THE COTTON INDUSTRY IN JAPAN.

HACHIRO H. FUKUHARA, Tokio, Japan.

CONTENTS.

Introduction.
(1) The Past.
  (*a*) Cotton Spinning.
  (*b*) Cotton Weaving.
(2) The Present.
  (*a*) Distribution of the Cotton Mills in Japan.
  (*b*) Situation of the Japanese Cotton Industry in the World.
  (*c*) The Productive Capacity and the Home Demand.
  (*d*) China as an International Market.
  (*e*) The Competition with Bombay Yarn in the Chinese Market.
  (*f*) The Profits and Dividends of the Japanese Mills.
(3) The Future.
  (*a*) Is the Prosperity of the Japanese Cotton Mills a Barrier to that of the United States?
  (*b*) The Advantages of the Japanese Mills.
  (*c*) The Disadvantages of the Japanese Mills.
  (*d*) Conclusion.

INTRODUCTION.

Mr. President: Gentlemen, I have the great honor of reading this paper concerning the Cotton Manufacture of Japan, before this great convention of the most famous association of its kind in the United States. It also gives me unusual pleasure to attend this memorable convention at the time of the Pan-American Exposition at Buffalo, which was conceived in the Cotton States in 1895.

Since I came to your country about two years ago to learn the commercial routine of the cotton business, I have travelled several times in the South, as well as in the North. While I have been travelling I have met many planters, manufacturers, exporters, and mill owners in both sections of your country who have, at various times, pressed me to write of the present condition of cotton manufacturing in Japan and my views of the future prospect of that industry.

I thought the best opportunity to answer these questions, constantly asked me, would be at the convention of your Association, and so bring before the most prominent cotton manufacturers of this country the rising industry in the East, and this led me to write the following paper in the briefest form possible.

This paper I have devoted exclusively to the factory systems, although there are cotton goods made by hand looms to a great extent throughout my country, of which I expect to write at another time.

Mr. WOODBURY, the Secretary of your Association, asked me to obtain photographs showing the primitive methods of spinning in Japan, for the purpose of engraving and having them appear in the Association's reports. It was also my desire to have them at the convention, but owing to the great distance from home I have been unable to procure any. I will, however, furnish photographs of some of the modern mills for illustrating the Transactions of your Association.

THE COTTON INDUSTRY OF JAPAN.

During the last thirty years, the progress of Japan toward the civilization of the Occident and toward assimilation to the Christian nations has been absolutely without precedent or parallel. Forty-five millions of people during half a century have changed in everything: in government, in education, and in customs, in commerce and industry, in army and navy. They are scarcely recognizable as the same nation of 50 years ago.

Japan, the oriental Yankee nation, is today showing herself the most progressive nation of the East, in building ships, constructing machinery, in projecting railways and steamship lines, in establishing schools and universities, and, in a thousand ways, she is making gigantic strides. Is this not a remarkable event in the history of the 19th century?

Among all industrial developments in modern Japan, that of the cotton industry ranks first. It has made wonderful progress in the last twenty years. Now let me trace, in outline, the origin and progress of this important industry.

THE PAST.

(*a*) THE COTTON SPINNING.

About the middle of the last century some foreign vessel came to the Riu-chu Island which was controlled by Saihin Shimatsu, the famous Daimyo (feudal lord). At that time, all Japan was divided among about three hundred lords; of these Saihin was the most powerful chief and was head of the largest province called Kagoshima.

The foreign merchant who came to Riu-chu Island had cotton yarns made in England which attracted the attention of the far-seeing feudal lord and led him to appreciate the advantage of power machinery.

Saihin Shimatsu, the heroic Daimyo, reformed the civil government of his state, established an arsenal, disciplined the

people with a military education and encouraged the navigation of steamships. After he saw the yarn he was anxious to establish a cotton mill in his state, but unfortunately, before he could put into effect his great idea, he died.

In 1862 Yoshimitsu, the son of this Daimyo, who succeeded to the idea of his father, had 6,000 spindles imported from England, and near the sea coast he established the first cotton mill in his native province, named "Isonohama" "Beach of Beaches". He hired three English engineers and two architects who were also English born, and had the mill built entirely of stone, costing hundreds of thousands of dollars, and he conveyed the fuel from Chikuzen, about 150 miles distant from the mills. It is not strange to say that at the time of the feudal system the facilities for transportation were in the poorest condition, just as in China at the present time. Consequently you can imagine what expensive coal the Daimyo consumed in his mill.

There was hesitation among his vassals because of the extensive equipment and vast amount of money that would be required. Patriotic Daimyo, however, persevered despite all opposition and discouragement. He made great efforts and finally began to enjoy an unrivalled reputation for his product, which was known as "Iso-Kase", "the yarn of the beach", throughout the country. It is said they used entirely the cotton grown in the country, although Japanese cotton is of short fibre and much inferior in strength and lustre to that of Bombay or of America, yet it is said they met the home demand.

It was the idea of the patriotic Daimyo to carry on the business for the good of the country and he was anxious to impart his enterprising spirit to all the other Daimyoes, that foreign yarn might be rejected and domestic cotton mills established throughout the country. Consequently he bought a piece of land near the central part of Japan named Sakai, which he thought would afford the people the best opportunity of seeing the mill in operation, and also be near the place where the most cotton was raised. He ordered an English-merchant to ship 2,000

spindles of mules, but alas! when machinery and tools arrived it was just the time when the restoration of Meiji occurred.

This was thirty-four years ago and marks the abolition of the feudal system and the concentration of the controlling power in a central government, and the present Mikado has been the maker of "our New Japan".

On account of the above complications the Daimyo postponed the equipment of the mill until 1870, when the entire restoration settled down. The "Sakai Cotton Mills" was the name first given; later changed, it has been known as "Senshu Cotton Mill" up to the present time.

Five or six years before the Restoration, the citizens of Yedo (the old name of Tokio) suffered from the high prices of commodities. Consequently the feudal government invited the wholesale stores of the city to advise them as to the best methods of lowering prices. Manbei Kashima, the famous cotton yarn merchant of the city, proposed establishing a domestic cotton mill, to reduce the price of cotton yarn. The officers of the government received the proposition with so much favor that they ordered Kashima to establish the mill.

Despite his efforts, barely eight friends would join him in the undertaking, appreciating the value of his project. They ordered from England, in 1867, 700 spindles. These reached Japan in the midst of the Restoration, so they asked to have the machinery kept in the English merchant's warehouse till peace was restored.

During the complication some of the associates of Mr. Kashima began to fear for the success of the mill, as it was an entirely new business and demanded vast sums of money. Finally some of them, fearing to risk so much, left him. He tried to form another association, but failed.

In 1869, Mr. Kashima, the ambitious manufacturer, bought a mill site near the Takino River, a suburb of Tokio, under the auspices of the government. He hired an English engineer to operate the machinery, but on account of the engineer being inexperienced and the equipment not complete, the mill did not

succeed. All his associates were disappointed and left Mr. Kashima alone.

But, thanks to God, Mr. Kashima was a man endowed with more than ordinary intelligence, force of will, energy and courage. After striving against all difficulties, single handed, he opened a factory under the name of the "Kashima Cotton Mill". This was the first established by a private individual; it commenced operation in 1870. A few years later the "Nagasaki Cotton Mill" was incorporated.

In 1879 the first public mill was established at Himegi by the Prefecture. Following this, the "Shubuya Cotton Mill" was established in Osaka, which subsequently became the centre of the cotton industry of all Japan.

Ten years after the Restoration, civil war, the so-called "Southwest War", broke out. At the close of the war, paper money was very much depreciated, as the government had issued too much paper money. Consequently gold coin had begun to flow out of the country, leaving only silver. To remedy this, Count Masayoshi Matsukata, the famous Minister of Finance, attempted to encourage the establishment of cotton mills near the cotton goods markets, as well as near the cotton producing districts, for the purpose of securing the balance of trade, with the aid of the substantial subsidy of the government, He proposed to act as follows:

First, to import 10 lots of 2,000 spindles each, from England, with the business fund of the government.

Secondly, to sell the spindles to the people, who had the privilege of paying the price within ten years, without interest.

Thirdly, to send government engineers to teach the operators in each mill how to use the machinery.

Fourthly, to establish two large mills in the Prefectures of Aichi and Hiroshima, under the auspices of the government.

Fifthly, to encourage the people to establish mills through the efforts of the governors of the Prefectors.

As a result of these methods of encouragement, many mills were established in Osaka, Nara, Hiogo, Okayama, Miye,

Yamanashi, Shizuoka, Tochigi and Miyagi,—almost all the Prefectures along the entire East coast. Still all of these mills were on a small scale except the Osaka Cotton Mill, which had over 10,000 spindles.

After a few years the Japanese money market had again become secure and the rate of interest run down. Then the government issued bonds at 5 per cent. to draw in all the unconvertible paper money.

The Capitalists were not satisfied with the 5 per cent. interest on the bonds as they could get more profit otherwise, and invested their money in business enterprises, especially in the cotton industry, which had just begun a remarkable development under the Subsidy Bill.

It is said that the total capital invested in the various forms of business in those few years amounted to $21,500,000 of which $7,500,000 was invested in the cotton industry.

The unforseen development springing up, mushroom-like, by the speculative excitement, did not everywhere bring success as there were not stable foundations, and some of the corporations failed in the business depression.

In 1889, the total number of mills in operation was 28 and the number of spindles amounted to 213,000.

These mills producing yarn up to No. 10, from mixed domestic and China cotton, displaced a vast proportion of the handmade and foreign yarn, promising long prosperity to the mill owners.

After a few years the manufacture of cotton was undertaken at Shanghai which had the effect to offset the great hope of the Japanese cotton mills.

When mills started in China, the Chinese cotton which the Japanese mills entirely depended upon, began to be consumed in that country and the importation of the cotton decreased year by year and the prices rose so high that the Japanese mills could not profitably compete with Manchester and Bombay in the manufacture of the yarns which are consumed in our

market, and at the same time vast amounts of foreign yarn again made its way to our market from which it had been retiring.

Beside this we had commercial depressions soon after so that even the imported goods accumulated at the Kobe harbor to the amount of 10,000 bales, and considerable amounts had to be disposed of at a reduced rate. This was the worst period in the history of the cotton industry in Japan, and our mills sank to the bottom in the depression and many believed that manufacturing in Japan had reached its declining turn.

In 1891, however, the Japan Mail Steamship Company (Nippon Yusen Kwaisha) started navigation between Japan and Bombay, which had the effect of reducing the importation of Bombay cotton, at which the Japanese mills started to make finer yarn than before (16 to 20 counts), for which there was ample consumption in our market as well as in China.

By and by the Japanese mills revived, and their product began to excel the Bombay yarn not only in our domestic market, but also to some extent in the Chinese market.

Later, American cotton made its way to my country; then the mills commenced to make yarn over number 20, mixing Chinese, Bombay and American cotton and made great efforts to control the home market which used to buy the imported yarn.

Since then, the condition of the mills has materially changed for the better.

In 1894 our government took off the tariff on the exportation of yarn and goods, and also the import duty on raw cotton in order to encourage the exportation of the manufactured cotton.

In 1896 most of the Bombay cotton supply was stopped on account of the Bubonic Plague. The papers say the amount of damage to 60 cotton mills in Bombay during one month was 2,220,000 rupees. Then Japanese mills, which were looking for an outlet for their products, took this opportunity to secure a share of the trade in the Celestial Empire and other Eastern markets, which in 1899 amounted to 102,360,832 kin in weight (13,613,770,656 pounds) costing 14,260,719 dollars.

It is true that Japan is anxious to promote trade with China, to export her excess, as she is suffering from over-production. But alas! The Boxer outrage closed the market for the yarn, and caused in all the cotton mills an accumulation of the products which led Japanese mills to reduce their production 40 per cent., at the middle of last year.

Having now traced, in outline, the origin and progress of our cotton spinning, I may here insert the table which shows very clearly the growth of this industry.

Date.	Number of Mills.	Number of Spindles.	Production.
1862	1	5,456	. . . .
1870	2	7,456	. . . .
1871	3	8,204	. . . .
1879	4	10,204	. . . .
1880	5	12,204	. . . .
1881	7	16,204	. . . .
1882	13	28,204	. . . .
1883	16	43,704	. . . .
1884	19	49,704	. . . .
1885	22	59,704	. . . .
1886	22	71,604	6,486,942 lbs.
1887	21	76,604	9,649,775 "
1888	24	116,276	13,275,858 "
1889	28	215,000	27,936,117 "
1890	30	277,895	43,683,075 "
1891	36	353,980	60,408,542 "
1892	39	385,314	85,395,900 "
1893	40	381,781	89,482,550 "
1894	45	539,074	121,833,400 "
1895	47	580,945	152,787,308 "
1896	61	757,196	167,339,375 "
1897	65	793,022	213,014,983 "
1898	74	926,991	268,543,508 "
1899	78	1,086,721	301,813,875 "
1900	79	1,320,988	256,867,000 "
Actual increase since 1888	55	1,004,712	243,591,142 lbs.
Percentage of increase since 1888	104.17%	103.60 %	108.16 %

From the above sketch it is readily seen that the Daimyo Shimatsu who established cotton mills in 1862 is the father of the cotton industry of Japan, and that the factory system of spinning was not adapted to any considerable extent until 1889, when the government encouraged it with the substantial subsidy,

and also that the sudden development of the industry brought over-production which compelled our spinners to secure the foreign market for their excess.

(*b*) COTTON WEAVING.

In 1886 the first weaving factory named "Konagigawa Cotton Manufacturing Company" was incorporated at Ozi by the capitalists of Tokio; and the new mill with 200 looms began operation in August, 1887.

This has been followed by another corporation at Osaka which operated 330 looms and intends to add 400 more, from its success.

To illustrate the progress made in manufacturing of cotton the following table shows the names of each concern with the number of looms:

Corporation.	No. of Looms.
Osaka Cotton Mills,	700
Miye " "	560
Wakayama " "	200
Onagi " "	414
Kioto Flannel "	303
Okayama "	246
Tenma "	423
Nippon "	253
Kanakin "	506
Total,	3,605

It is a notable fact that the most of the industries of Japan were developed by the special encouragement and protection of the government, however, the manufacturing of cotton goods began to develop through the continuous efforts of individuals.

Consequently, during the last decade, most of the mills which started weaving met many difficulties, simply on account of the want of experience and skilful employees.

It was in 1897 that most of the mills succeeded in making the fabrics and in meeting the market demand profitably. In 1899,

the annual dividends of weaving mills reached 20 to 30 per cent. yearly which attracted the attention of the yarn mills.

In 1900, many mill owners who were suffering from over-production, encouraged by the bright prospect of the cotton weaving business, came over to this country to buy new looms, and ordered over 1,300 looms from the Draper Company and two or three others.

Later the other cotton corporations intend to increase the number of their looms; if they complete their plans our weaving capacity will be 7,500 looms.

When the manufacturing of cotton by machinery was started in Japan it was believed that they could not profitably make the goods, even the lower grades, and the limit of ability of the Japanese mill owners would be found in the production of the coarser yarns.

At the present time, however, Japanese mills are compelled to make cotton goods on account of over-production of yarn.

The cotton goods made in my country are mostly consumed in the domestic market and those sent to China are of comparatively small value; but it is safe to say that the export to China, Korea and other Oriental countries is increasing every year, which in 1900 amounted to $2,861,834 including hand-made products.

The following statement shows the exact situation of export trade of sheeting and drill which constitutes the principal cotton goods for export.

Date.	Sheeting.	Drill.	Total.
1900	$877,206	$238,957	$1,116,163
1899	334,537	206,593	541,129
1898	193,113	117,363	310,476
1897	173,018	25,425	198,443
1896	91,057	12,434	103,490
Increase during 5 years,	$786,049	$226,523	$1,012,673
Percentage of increase since 1896,	89.62%	94.80%	90.73%

Beside, we export blankets, towels, etc.

Finally I ask you to give your attention to the importation of English made yarn and goods into Japan.

The following table shows precisely the amount of yarn and goods imported since 1897.

Date.	Import of yarn.	Import of goods.
1899	$2,658,967	$4,523,714
1898	4,453,180	5,486,927
1897	4,940,748	4,831,820
Decrease during 3 years,	$2,281,781	$308,106
Percentage of decrease during 3 years,	46.18%	6.40%

From the above table it is readily seen that the importation of yarns is decreasing rapidly but that of goods does not practically decrease. Although there was a decrease in 1899, it was an effect of over-importation in 1898.

From the general view of the history of our cotton industry, it is sufficient to say that the Japanese cotton industry has so far improved remarkably and that our mill owners are devoting themselves to making a finer yarn and a higher grade of goods for domestic purposes just as Bombay manufacturers are undertaking. But I assure you that it will be a long time before they are able to manufacture satisfactorily exclusively for Japan.

PRESENT.

(a) DISTRIBUTION OF THE COTTON MILLS IN JAPAN.

The Japanese cotton mills which sprang up under the protection and encouragement of the government, were, in consequence, located quite near the cotton fields. When they started the mills they consumed chiefly domestic cotton with a little of Chinese, as there was no navigation to bring Bombay and American cotton, and as they had no experience in making fine yarns. At the present time, however, they import raw material from China, India, Egypt and the United States, and the domestic cotton has practically no use in the mills which

are operated by power. It is only spun, by primitive methods, by farmers.

When cotton mills started in Japan, Osaka, the largest industrial and commercial centre of Japan, had an advantage in the matter of raw material, labor and transportation, so that it occupied the position as the centre of the cotton industry, having about one-third the number of spindles in the whole country.

The following statistics show the exact distribution of the mills:

Name of Perfectures.	No. of Mills.	No. of Spindles.	No. of Looms.
Osaka,	20	463,136	2,629
Okayama,	8	116,152	246
Hiogo,	6	149.269	204
Miye,	5	90,004	560
Aichi,	5	114,060	. .
Kioto,	5	40,236	. .
Fukuoka,	4	57,000	. .
Hiroshima,	4	42,952	. .
Yehime,	4	28,196	. .
Tokio,	3	64,732	400
Yamanashi,	3	33,720	. .
Wakayama,	3	27,476	200
Nara,	2	31,872	. .
Shizuoka,	2	3,704	. .
Kumamoto,	1	10,368	. .
Oita,	1	10,368	. .
Toyama,	1	10,192	. .
Kagawa,	1	10,000	. .
Tokushima,	1	5,376	. .
Tochigi,	1	5,048	. .
Saitama,	1	4,900	. .
Miyagi,	1	2,228	. .
Total,	82	1,320,989	4,239

Beside these we have twelve twisting factories which will have 86,980 spindles when their plans are complete. If we add these spindles, the total number of the Japanese spindles is 1,407,968.

(*b*) SITUATION OF THE JAPANESE COTTON INDUSTRY IN THE WORLD.

The growth of the cotton industry in Japan during the past 20 years has been so rapid that it has frightened the mill operatives of the whole world; but when we compare the number of Japanese spindles with the total number of the world, we have less than one and three-tenths per cent.

In a table of the spindles of all countries, Japan ranked twelfth in 1899.

United Kingdom,	45,400,000
The North of the U. S.,	14,150,000
Germany,	7,884,000
Russia,	6,000,000
France,	5,300,000
India,	5,002,473
South of the U. S.,	3,950,000
Austria and Hungary,	3,140,000
Spain,	2,615,000
Switzerland,	1,972,000
Italy,	1,886,000
Japan,	1,250,000
Poland,	965,000
Belgium,	900,000
China,	560,048
Canada,	500,000
Mexico,	448,156
Sweden,	360,000
Holand,	350,000
Portugal,	230,000
Norway,	118,000
Greek,	70,000
Total,	103,050,677

As the preceeding table shows, Japan holds a position next to Italy and operates less spindles than Switzerland, the smallest country of Europe and if I compare Japan with the United States in 1900, our total number of spindles is 6.27 per cent. of the aggregate of all in the United States.

The following table shows percentages of the Japanese spindles compared with those of large cotton towns in the North.

Japan occupies in cotton spindles:

6.27	per	cent.	of all in	the United States.
7.88	"	"	"	Northern States.
30.70	"	"	"	Southern States.
43.42	"	"	"	Fall River.
84.36	"	"	"	Providence.
96.47	"	"	"	New Bedford.
132.26	"	"	"	Lowell.
198.39	"	"	"	Lawrence.
224.14	"	"	"	Manchester, N. H.

From the preceeding table you will learn that Japan has about the same number of spindles as New Bedford, Mass.

As regards weaving machinery we have nothing to say, as we have only 3,600 looms in all, which are less than those of one mill in this country.

Although our mill owners intend to increase 7,500 looms in a few years it would be less than that of Lewiston, Me., one of the smallest cotton mill cities in New England.

Whether the ratio of growth of the past twenty years can long be maintained is a great question which commands my attention in the last part of this paper.

(*c*) THE PRODUCTIVE CAPACITY AND HOME DEMAND.

The following tables prepared by our government exhibit the productive capacity of the cotton mills of Japan since 1894. It should be borne in mind that these returns contain the products of the private firms operated on a small scale.

(1) CAPITAL STOCK AND NUMBER OF SPINDLES IN OPERATION.

Date.	Capital Stocks.	Average Number of Spindles in Operation.
1894	$6,654,015	476,123
1895	8,196,029	518,736
1896	11,430,355	692,384
1897	18,207,364	768,328
1898	21,171,040	1,027,817

The figures given under "capital stock" represent merely capital stock and do not include all of the capital stock devoted to production in the various forms. The average number of spindles in operation is larger than the number of spindles I have cited in the history. This is because I included the number of spindles in the private firms on a small scale in the latter figure.

(2) Days in Operation and Average Working Hours.

Date.	Average Days in Operation.	Average Working Hours.
1894	277	22
1895	297	22
1896	294	22
1897	284	19
1898	293	20

It will be noted that Japanese mills generally run 22 hours each day, but as there are 24 small private mills which run 14 hours, the average working hours of the total establishments was decreased to 20 hours.

(3) Labor and Its Compensation.

Date.	Average Number of Persons Employed.		Average Daily Wages.	
	Female.	Male.	Female.	Male.
1894	26,923	8.229	4.5 cts.	8.6 cts.
1895	31,140	9.650	5.0 "	9.0 "
1896	36,087	11.394	6.0 "	9.9 "
1897	35,059	9.933	6.8 "	11.5 "
1898	50,620	16,183	7.5 "	12.4 "

From the above table it is readily seen that the vast proportion of the Japanese mill operatives are female. It is also noted that the figures of wages were stated in American cents for easier comparison.

(4) COAL.

Date.	Consumption of Coal.
1894	131,301 tons.
1895	156.616 "
1896	192,387 "
1897	241,791 "
1898	370,056 "

It will be remembered that the Japanese mills run day and night, so that you will realize the amount of the consumption of coal. It will be also noted that the average consumption of coal per hour for one horse power is about three pounds and a half.

(5) THE PRODUCTION.

Date.	Amount of Yarn Manufactured per annum.	Amount of Waste Yarn.	Amount of Waste Cotton.	Cotton Used per annum.
1894	121,833,400 lbs.	15,136,108 lbs.	1,591,808 lbs.	151,361,108 lbs.
1895	153,641,758 "	20,194,675 "	2,098,992 "	181,427,883 "
1896	171,545,708 "	24,299,583 "	2,734,658 "	206,696,817 "
1897	217,784,333 "	30,887,583 "	9,809,158 "	267,235,358 "
1898	268,026,991 "	41,505,725 "	4,653,409 "	354,538,800 "

As regards the number of yarn and grade of cotton goods, I have no official statistics. Consequently I will cite here the reports of the Cotton Spinners' Association of Japan, showing the products during May, 1901, compared with that of 1900. It should be borne in mind that these returns do not show the exact capacity, as the Japanese mills were suffering from the Chinese trouble.

(A) NUMBER OF YARN.

		May, 1901.	May, 1900.	Increase (+) or Decrease (−).
Average Number of Yarn,	Ring	20	20.5	− 5.
	Mule	41	22.5	+15.5

(B) NUMBER OF YARN AND ITS PRODUCTION IN MAY, 1901, COMPARED WITH APRIL.

No. of Yarn.	Production in May, 1901. (Bales)	Production in April, 1901 (Bales)	Increase (+) or Decrease (—)
Under 10	523.0	590.0	— 67.0
20	1,705.5	1,976.5	— 271.0
11	618.0	851.5	— 233.5
12	1,887.0	3,257.5	—1,370.5
13	834.5	1,216.0	— 382.5
14	2,740.0	3,383.0	— 643.0
15	1,495.5	1,499.5	— 4.0
16	24,367.5	18,685.5	+5,682.0
17	9.5	28.0	— 18.5
18	642.5	917.5	— 275.0
20	596.5	512.0	+ 84.5
22	94.5	80.5	+ 24.0
24	39.0	19.0	+ 20.0
30	—	6.0	— 6.0
38	14.5	—	+ 14.5
40	—	2.5	— 2.5
Left			
Under 10	62.0	22 0	+ 40.0
10	335.5	4.0	+ 31.5
12	118.0	245.0	— 127.0
13	213.0	202.5	+ 10.5
14	234.0	32.0	+ 202.0
15	274.5	140.0	+ 134.5
16	424.0	443.5	— 19.5
18	195.0	305.5	— 110.5
20	13,504.0	13,159.0	+ 346.0
21	—	16.0	— 16.0
22	94.0	37.5	+ 56.5
24	110.5	94.5	+ 16.0
28	245.0	417.5	— 172.5
30	459.5	488.0	— 28.5
32	926.0	913.0	+ 13.0
36	20.0	9.0	+ 11.0
38	2.5	5.5	+ 17.0
40	106.0	39.0	+ 67.0
42	190.0	193.5	— 3.5
80	—	1.0	— 1.0
Twist 16	112.0	—	+ 112.0
20	227.0	232.0	— 5.0
32	711.0	296.5	+ 414.5
42	1,529.5	1,669.0	— 139.5
60	246.0	274.5	— 28.5
80	546.0	519.0	+ 27.0
Extra	47.5	23.0	+ 24.5
	307.5	177.0	+ 130.5
Total,	56,807.5	52,984.0	+3,544.5

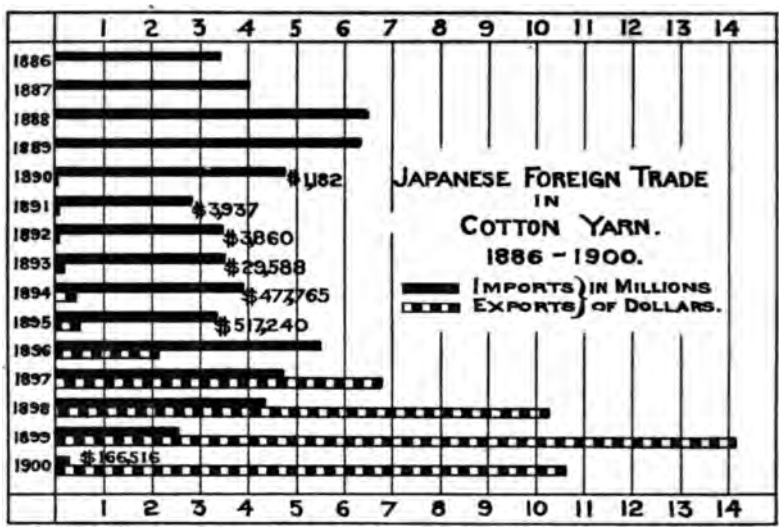


FIGURE 1.

(C) THE COTTON GOODS MADE IN MAY, 1901.

Corporation.	No. of Looms in Operation.	Grade of Products.	Amount of Product.	Average Product per Loom per Day.
Osaka,	900	Drill and Sheeting,	1,129,132 yds.	46.50
Kanakin,	464	Seeeting,	507.009 "	40.36
Tenma,	372	Drill and Sheeting, etc.,	219,498 "	21.79
Nippon,	250	ditto,	278,831 "	41.31
Okayama,	248	Drill	311,616 "	46.53
Mie,	560	Drill and Sheeting,	630,270 "	41.68
Onagigawa,	279	Drill and Sheeting, etc.,	247,060 "	32.20
Wakayama,	200	Drill and Fancy Flannel,	240,649 "	42.99
Total,	3,273		3,564,063 yds.	39.17

By reference to the preceding presentations it will be seen that the product of cotton yarn and goods in Japanese mills is insignificant. If I compare the product of the Japanese mills with that of the United States it is like "a candle to a comet". It was, however, too much progress in Japan, because the expansion of the cotton industry was much faster than the home demand.

At the present time about 800,000 spindles can readily supply all the yarn needed for home consumption, and the one-third of the spindles must find foreign markets. Since Japanese manufacturers met over-production, they are using every effort to find an outlet for their surplus products. Consequently the exports of cotton yarn have shown a rapid development in the last ten years, as follows:

THE AMOUNT OF EXPORT OF THE COTTON YARN OF JAPAN.

Date.	The Amount.	The Value.
1891	43,075 lbs.	$ 3,937.00
1892	43,563 "	3,860.00
1893	420,271 "	29,588.00
1894	4,706,694 "	477,765.00
1895	4,698,748 "	517,240.00
1896	17,256,368 "	2,014,713.00
1897	55,906,517 "	6,745,099.00
1898	91,548,905 "	10,058,293.00
1899	136,149,866 "	14,260,719.00
1900	83,284,148 "	10,294,632.00
1901 (to April)	20,342,616 "	

(*d*) CHINA AS AN INTERNATIONAL MARKET.

Since the Chino-Japanese War, the attention of all civilized nations has centered upon "commercial China" and especially in cotton manufacturing countries a great deal has been said and written about the value of North China as well as "China Proper," but I find sometimes mistakes about Oriental conditions. I will, therefore, try to set clearly before your minds the actual conditions in China and the leading facts with regard to a possibility of development.

(1) *Present Demand for Cotton Goods in China.*

If we look over the list of China's imports we will find that

the principal cotton manufacturing countries imported cotton goods in the following proportion:

(1)	India (yarn),	$22,000,000
(2)	Great Britain (yarn and goods),	20,000,000
(3)	Japan (yarn),	12,000,000
(4)	The United States (heavy goods),	10,000,000
(5)	France (goods),	2,000,000
(6)	Russia "	2,000,000
(7)	Belgium "	800,000
(8)	Germany "	600,000
(9)	Netherlands "	250,000
(10)	Italy "	50,000
(11)	Austria-Hungary (goods),	5,000
		$69,705,000

It is impracticable to state accurately the proportion of the above amounts in number of bales of raw cotton. I will, however, try to estimate the amount of raw cotton which was consumed to make those goods, with a view to showing you the consuming power.

	Bales.
India,	400,000
Japan,	200,000
England,	200,000
The United States,	100,000
Other countries,	30,000
	930,000

This would make the total of cotton goods imported into China about one million bales. Besides this, we must consider the production of cotton in China to decide the true demand of the Chinese market.

Since China began to make extensive use of cotton fibre, many centuries ago, the growth of cotton has reached immense proportions in the valley of the Yang-tze-Kiang, where the soil is very fertile. Although there are no official statistics of the cotton crops in that country, the closest estimate is 1,300,000

FIGURE 2.—MAIN FACTORIES OF THE MIYE COTTON MILLS AT YOKKAICHI.

FIGURE 3.—THE TUA BRANCH OF THE MIYE COTTON MILLS.

FIGURE 4.—THE AICHI BRANCH OF THE MIYE COTTON MILLS.

FIGURE 5.—THE AICHI BRANCH OF THE MIYE COTTON MILLS.

FIGURE 6.— VIEW OF THE HIRANO COTTON MILLS.

FIGURE 7.—SPEEDER ROOM, HIRANO COTTON MILLS.

FIGURE 8.—SHIPPING ROOM, HIRANO COTTON MILLS.

bales of 500 pounds net, consumed in that country, exporting only ten per cent. to other countries. If we add this crop to the total amount of import, there are about two millions and a quarter bales consumed in the Chinese Empire.

Supposing China to have a population of 400,000,000, a conservative estimate, the present demand for cotton goods does not exceed three pounds per head. According to the "Cyclopœdia of India" the United States has the highest consuming power in the line of cotton goods and India comes next, consuming ten pounds per capita; but the best informed believe that this is over estimated in the case of India. According to the most reliable estimate they do not consume over four pounds per head.

What is the consumption of Japan? Japan produces about 100,000 bales of 500 pounds yearly and imports about 700,000 bales but they do not consume all in the domestic market. Because after we have manufactured it we export it to other countries to such an extent that the demand of our people does not exceed five pounds per capita.

The American manufacturers who never visit our shore imagine that all Oriental people are clothed with cotton exclusively and that the Oriental has the highest consuming power of cotton goods in the world, so that some people seem perfectly amazed when told that China's requirement for cotton is not so large as American manufacturers have supposed, but such is undoubtedly the case.

While I was in the South one of the mill owners told me that in the United States where people are chiefly clothed in wool, the consumption of cotton is estimated at over ten pounds per head, and consequently Oriental people must consume more per head. According to my humble judgment, the American people are clothed with cotton. Especially in the last few years the consumption of cotton in the woolen mills is increasing to a considerable extent. I have, therefore, confidence that the vast majority of the American people are clothed with cotton and not with wool.

In China there are four regular classes, the mandarins and literary, the agriculturists, the mechanics, and the merchants. True, all mandarins and a vast proportion of the wealthy people of other classes wear silk, but at the same time there are many poor people who wear fabrics made from hemp. Another reason why the Chinese consume less cotton is the uncivilized state of that race.

As you know, the Chinese is the dirtiest race in the world. Although they monopolize the laundry business of the world they do not wash their own clothes. Is it not strange to say that there is no professional laundry in China except in the sea ports where foreigners live, and all dirty clothes are washed by women at home occasionally, when they get dirty, but it is not the custom to wash regularly once a week as in Western countries. Furthermore, in the Chinese Empire they do not use soda and soap which contains lye, to economize the time to whiten, but which damage the fibre of the fabrics to a considerable extent. It is sufficient to say, therefore, that the Chinese people consume one suit to three or four of Western people. These are the reasons why Chinamen consume less cotton goods than has been supposed.

(2) *The Future Demand for Cotton Goods in China.*

What is the possibility of development and what kind of goods does she need in the future?

It is a universally known fact that the Chinese Empire has the largest population in the world, and that if this country could be thoroughly opened up by railroads, which are the most pressing need of the Empire, her demand for cotton goods would undoubtedly be increased to a considerable extent. I venture, however, to predict that China's demand will not exceed four pounds per head in the next ten years. In other words, China's requirement for cotton goods will be under 3,000,000 bales, about one-fifth of the total consumption of the world, if the whole field is thoroughly opened. If I deduct the Chinese

crop from this amount, the net demand in the line of cotton goods in China will be one million and three-quarters bales of 500 pounds net.

It is, however, believed by the best informed that the construction of railroads would take a long time in that country. Although there are many lines that might be constructed by the Powers in their respective "spheres of influence", the vast majority of Chinamen do not see the utility of railroads as a commercial agency and always oppose them from superstition. We must, therefore, recognize that the Chinese demand will increase comparatively slowly.

I have heard from prominent manufacturers that the progress of the cotton industry of the world is far faster than the progress of the world's demand, and that if the number of spindles of the world increases in the same ratio as in the last ten years, all cotton manufacturing nations will surely suffer from the overproduction and serious competition is predicted between nation and nation and between section and section. I hope this is but a dream of thinkers.

(3) *Grade of Cotton Goods Consumed in China.*

From the list of imports in China I would say that cotton yarn ranks first, heavy goods second, and the lighter goods third.

The cotton yarns are chiefly imported from India and Japan and the heavy goods trade is a monopoly of the United States and lighter goods come from Manchester. In other words, cotton yarn is made by Asiatic mills, and heavy goods are a production of America and the finer yarn and lighter goods are made in Europe.

To decide the future field as well as the grade of cotton goods imported from other countries, we must consider the following subjects:

(a) Population.

Manchuria, as compared with the other provinces, is thinly populated, having only 7,500,000 inhabitants and its density is

about twenty per square mile against an average of 300 per square mile in the eighteen provinces of "China Proper". If I apply the three pounds rate, the demand of Manchester for cotton goods does not exceed 50,000 bales of 500 pounds net. It is, therefore, important to note that the greatest field for cotton goods in China lies in the South as well as in the Yang-tze-Kiang, which is commonly regarded as the "Sphere of Influence" of Great Britain.

(b) Standard of Living.

All travellers who have been in both sections of China agree that China is divided into three parts in the point of living.

(1) Mangoria, where the people live in the poorest condition, atttending herds of cattle, moving from place to place, mostly wearing fur.

(2) Manchuria, where the people live by agriculture, in moderate circumstances and want heavy goods which are chiefly supplied by the Southern mills of the United States.

(3) The Middle and South where the people live according to the highest standard of living in the Celestial Empire, and require finer yarn and lighter goods which are supplied by Manchester (England) mills.

From the above facts it will be noted that "China Proper" has a higher and greater consuming power than the North.

(c) Climate.

Manchuria, as well as the Northern provinces, has very severe winters, and even as early as November the Pei-Ho is blocked with ice which remains till February. Consequently heavy goods are chiefly consumed in the North. On the contrary, the Southern provinces have a very warm climate. The average temperature of Shanghai the "New York of China" is the same as that of Savannah, Ga., which is estimated at 66 degrees.

I am, therefore, inclined to believe that all cotton manufacturing nations will devote themselves to securing the market in "China Proper." Especially the United States will try to

expand her market to that section with the most strenuous efforts because she is now suffering from the rapid growing productive power in the domestic market.

According to my humble opinion, these are two important features which decide the trade expansion of the Great Republic in the China market.

Hand-Made.

In the great Yang-tze-Kiang valley there are large plantations of cotton and all the crop has been manufactured for many centuries by the country women at wages cheap beyond comprehension and they also consume most of the foreign yarn in that section. True that low class Chinamen, like other Orientals, favor hand-made, on account of durability.

It will be well, therefore, to understand that when you expand your trade to that section, the competition between factory-made and hand-made will undoubtedly arise in that section. Although factory-made would excel hand-made in the long run, there will be severe competition between them at least during the first ten years.

English-made.

The chief market for American cotton goods in China is North China, where heavy fabrics are in great demand from the climatic condition, but if you want to expand your market you must invade the great Yang-tze-kiang valley where the English-made practically control.

It will be well, therefore, to forecast that in the near future you will have severe competition with England in the middle as well as in the south of the Celestial Empire.

I am told by the best judges of oriental trade that the prices of the American lighter goods, so far, are higher than the English-made, and the United States can never be a successful rival of Great Britain in Southern China, except your manufacturers form combinations to save the cost of production or get substantial subsidy of the government.

We, Oriental peoples, are all attention upon the future contest between the United States and Great Britain in "China Proper."

(4) *Manchurian Problem.*

The Manchurian problem still remains a question of absorbing interest to all commercial powers even after Russia has given up her Oriental programme for the administration of that vast and fertile province. Of course Russia cannot be expected to abandon her ambitious programmes forever just on account of that timely intervention of the Powers, in other words the tact and astuteness that characterize her diplomacy may one day bring the matter to a conclusive issue. What attitude should all cotton manufacturing nations take on this important question?

Suppose the Northern power declare her sovereignty over Manchuria; all foreign goods are excluded from that province by the high tariff wall.

Although there are very favorable guarantees of the so-called "Open Door," in the diplomatic circle, it is conceded by all Orientals who are familiar with the traditional policy of the Northern Empire that the guarantees are only temporary, and the free port of Dalny is but a pretention that she may grasp Manchuria and also, that after Russia accomplished her seizure of the vast territory of North China, she will build her high tariff wall at Manchuria just as she excluded foreign goods from Siberia at the beginning of this year.

If such unfortunate events occur, all cotton manufacturing countries must suffer to a more or less degree. Especially the Southern mills of this country, which practically depend upon the market of Manchuria will be compelled to find another outlet in "China Proper" or South America, where comparatively higher grades of cotton goods are in demand.

I venture, therefore, to say that the pressing need of the great commercial powers is to prevent the partition of China with active coöperation, and to protect the commercial interests of all nations in Manchuria as well as in "China Proper".

I know the history of the territorial expansion of Russia in one unbroken growth, ever since the time of Peter the Great. I do not, however, agree with the majority of our people who regard

Russia as the National enemy, but I also recognize the necessity for the protection in Manchuria of her peoples' property and for the maintenance of her railroads, which I regard as a commercial agency to the world's commercial progress. On the contrary I radically oppose any scheme to absorb Manchuria and to destroy the common interests of all commercial powers. Because if Russia permanently occupies Manchuria the dismemberment of the Celestial Empire is unavoidable.

In short, the pressing need of all cotton manufacturing nations is to prevent the partition of China and to open Manchuria to the world's commerce by the joint efforts of the Powers.

TABLE SHOWING CONSUMING POWER OF CHINA.

Population.	5 lbs. rate.	4 lbs. rate.	3 lbs. rate.	2 lbs. rate.
500,000,000	5,000,000 Bls.	4,000,000 Bls.	3,000,000 Bls.	2,000,000 Bls.
450,000,000	4,500,000 "	3,600,000 "	2,700,000 "	1,800,000 "
400,000,000	4,000,000 "	3,200,000 "	2,400,000 "	1,600,000 "
350,000,000	3,500,000 "	2,800,000 "	2,100,000 "	1,400,000 "
300,000,000	3,000,000 "	2,400,000 "	1,800,000 "	1,200,000 "
250,000,000	2,500,000 "	2,000,000 "	1,500,000 "	1,000,000 "
200,000,000	2,000,000 "	1,600,000 "	1,200,000 "	800,000 "

(e) THE COMPETITION WITH THE BOMBAY COTTON YARN IN CHINA.

It might be said that Japan had severe competition with Bombay in the Oriental market during the last few years, and it is a fact that a part of the trade of Bombay yarn is taken away by the Japanese competition.

The following tables which are made by Mr. O. SHOJI, the secretary of the Cotton Spinners' Association of Japan, shows clearly the details of the products of Bombay mills in 1898, and the prices of yarn and raw cotton since 1874.

Number of Yarn.	Amount.	Percentage.
Under 10 Counts,	85,954,892 lbs.	26
11 to 24	222,507,856 "	69
25 to 32	14,181,768 "	4
33 up,	2,004,668 "	1
Total,	324,649,184 "	100

PRICES OF YARN AND RAW COTTON IN BOMBAY FROM 1874 TO 1900.

Date.	Percentage of Price of No. 20 Yarn.	Broach Cotton.	Difference.
1874	100	100	0
1879	73	89	16
1883	73	92	19
1889	78	103	25
1894	71	96	25
1900	69	100	35

It should be borne in mind that the product of the cotton mills in the interior of India is consumed in domestic markets and that of Bombay, which is shown in the preceding table is principally made for export to the Oriental countries.

You will also learn that the prices of yarn are almost constantly going down in spite of the price of cotton which kept the same during the last quarter of a century.

As regards the quality of yarn, the best informed believe that the Japanese yarn is superior to that of Bombay in the following points:

(a) Japanese yarn has whiter color and more lustre which is most favorable in the Chinese market. On the contrary, Bombay yarn has a brownish color and less lustre.

(b) Japanese yarn is naturally twisted; but that of Bombay is a left twist which is not only inconvenient to the weaving but lessens the durability of the products.

(c) Japanese yarn has more elasticity and strength; consequently the hand weaver can make an even quality of goods.

(d) Japanese yarn is heavier than that of Bombay.

It would be folly, however, to attempt to conceal the merit in the Bombay yarn which is remarkable for the even twist throughout the whole length which prevents wrinkling.

It is also a universally known fact that the defect of the Japanese yarn is the unequality of color which is due to the ratio of mixing.

As regards the prices of Japanese yarn, our products are comparatively higher, as we consume more American cotton than Bombay. This is the reason why Japanese yarn under No. 10 cannot compete with Bombay in the North China market.

In short, Japanese yarn has, so far, successfully competed with Bombay yarn and has displaced it to a great extent in Japan as well as in China; but it is too early to predict that Japan will beat Bombay entirely, because Bombay manufacturers are tightening their belt and sharpening their weapons.

(f) THE PROFIT AND THE DIVIDENDS OF THE JAPANESE MILLS.

Since the Chino-Japanese war, our country has made gigantic strides in the line of commerce and industry. She used every yen of capital for the various enterprises, which caused a stringency in the money market. A great deal is said and written about the introduction of foreign capital to my country and is now gradually beginning to assume a practical form.

A scheme for obtaining gold dust in Hokkaido was started by some foreigners who are willing to get foreign money invested in connection with the undertaking.

The American Tobacco Company established a very large factory in Kioto for the purpose of making cigarettes to supply all Oriental people. Mr. MURAI who is called the "Tobacco King of Japan" is a partner of that factory and invested $2,500,000 which is supposed to be half of the total capital.

The Standard Oil Company invested capital for obtaining oil in Neigata through the joint effort of the leading Japanese business men.

In the line of the cotton industry a Frenchman who is engaged in some business in Siberia proposed to a director of the muslin factory at Osaka, last year, to establish a calico and cotton velvet factory in Japan, with a capital of two and a half or three million.

There are about 2,437 banking institutions in Japan at present with a total capital of about $261,750,379 but they are not enough to finance our entire industries which developed just like mushrooms.

It is true that Japanese cotton industry, is especially suffering from the scarcity of money, because they must pay high interest, over ten per cent. to the bank and they cannot issue bonds without a guarantee of nine per cent. at the present money market.

The dividends of Japanese mills run from twenty to thirty per cent. under normal conditions. Lately, however, the over production cut off their profits to a considerable extent.

The following statistics show the profits and dividends of the cotton mills in Japan:

	Second Half of 1899.	First Half of 1899.
Number of Companies,	58	65
Net Profit,	1,415,609 yen.	1,496,188 yen.
Reserve Fund,	512,132 "	335,281 "
Dividends,	1,632,724 "	996,276 "
Average Net Profit per company,	41,639 "	23,018 "
Average Reserve Fund per comp'y	8,830 "	5,158 "
Average Dividend per company,	28,150 "	15,327 "
Average Dividend per company,	9.2 %	4.9 %

(1 yen=$\frac{1}{2}$ dollar.)

In this table the decrease of seven mills is owing to amalgamation and less profits of the first half, due to the commercial depression. It would appear quite surprising to the American mill owners that Japanese mills yield dividends of five per cent. at the business depression, and with such dividends cannot hold the prices of stocks at par, but it is truly the case in Japan, because the rate of interest is high. It may be truly said that

the finance of the Japanese mills is in a worse condition since the "Boxer" trouble, as they have no ready money; and on the other hand the money market is suffering from stringency and the rate of interest is getting higher and higher. If "hard times" continue for a long while the stock price of the mills will go down to the bottom and will be a serious menace to the mill owners.

Lately some of the mills in Japan have arranged with cotton importers to get raw cotton on credit under the special contracts which is not favorable to the mills. It was only a relief to the mills who have no ready money.

In the following table is shown the stock price quotations in August, 1901, together with the amount of capital stock and the par value of the principal cotton mills.

Name of Place.	Names of Companies.	Capital Stock.	Par Value of Stocks.	Stock Price Quotation.
Tokyo,	Kanegafuchi Cotton Mills,	3,400,000 yen.	50	35.20
Osaka,	Osaka " "	1,200,000 "	50	18.00
"	Kanakin " "	1,000,000 "	25	16.00
"	Hirano " "	500,000 "	25	25.00
"	Settsu " "	750,000 "	25	41.00
"	Senshu " "	500,000 "	25	9.00
"	Fukushima " "	400,000 "	25	8.50
"	Meigi " "	850,000 "	25	13.20
"	Kishiwata " "	400,000 "	25	29.50
"	Nippon " "	1,000,000 "	22.50	25.50
Kobe,	Amagasaki " "	750,000 "	25	39.00

THE FUTURE.

(*a*) IS THE PROSPERITY OF THE JAPANESE COTTON MILLS A BARRIER TO THAT OF THE UNITED STATES?

I have often been told that the growth of Japanese cotton industry offers a real manace to the great American industry.

It is, however, conceded by Japanese manufacturers, especially those who have visited this country, that they have no special advantages over those of the United States, and the prosperity of the Japanese mills is not a barrier to that of this country.

Americans who never step on the "Island Empire of the East" imagine that the wages of mill workers in Japan are very low and the hours of labor are unusually long; which is a real ground to fear Japan as a sharp competitor in textile manufacture, and especially in cotton.

It is true that the Japanese mill workers are satisfied with the average daily wages for men, of less than 15 cents, and for women about nine and a half; and all mills in Japan run day and night changing hands at noon and mid-night, and the vast majority of mill workers are children who work 11 long hours with low wages. I am sure if a student of sociology came to my country to investigate the condition of child labor he could compose a master-piece better than Mrs. BROWNING'S "Cry of the Children."

But remember, gentlemen, low wages do not always insure cheap production. An example to testify to this is one of the cotton mills in Osaka which employs 2,600 workers, children under 15 years constituting about 50 per cent., to operate only 3,700 spindles.

In this country three hundred persons can operate the same number.

For instance, the Massachusetts Cotton Mills at Lowell have 122,000 spindles and 4,061 looms which are operated by 700 males and 1,500 females. If Japanese mills had the same spindles and looms, they would employ about 12,000 workers. If I divide this number by two, considering the total number of day

and night hands, they employ about three times as many as the American mills.

What a poor efficiency of labor it is! Mr. BYRON BRENAN, an English commissioner who investigated the Japanese cotton industry in 1898, said in his report to the government: "In Japan the production of each spindle is less than 20 per cent. as compared with that of England, and the quality of the products is also inferior, the amount of the waste being 20 per cent. larger than in English mills."

In my humble judgment there is certainly truth in this statement.

I have been through the cotton mill towns in the North as well as in the South of your country to investigate the textile industry.

When I was informed of their wages I was surprised at the high rate; but the labor cost when computed per spindle did not show so wide a disparity.

Besides, the low wages of Japan is only temporary; for the standard of living is getting higher and higher in my country and the wages are increasing. If you compare the wages at the end of 1897 with those in the spring of 1894 you can easily see that the wages of males has increased 45 per cent. and females 83 per cent. during four years.

I predict, therefore, that the time will surely come when Japan has no special advantages over the United States in the line of wages.

In short, Japan has much less advantage in the matter of labor than has been supposed, and if you carefully study the efficiency of labor, it will convince you that the "Yellow Peril" is only the imagination of Uncle Sam who never visits the Far East.

When I was travelling in the South I heard that some Southern manufacturers intend to try Chinese labor in the cotton mills.

True that Chinese laborers are cheaper than Japanese, but they have less efficiency and want more overseers, as they are not born as factory workers.

Go to Shanghai and look at the operation of the mill over there. At least one overseer is needed to watch 20 mill workers, sitting on the bench with a whip to beat the idle ones.

I feel confident in saying, therefore, that if Southerners try Chinese labor they will repeat the experience of the "Vesta Mills" at Charleston, which closed recently on account of the inefficiency of Negro labor.

(*b*) THE ADVANTAGES OF THE JAPANESE MILLS.

What are the true advantages of the Japanese mills? According to my humble judgment the advantages of the Japanese industry are in the free water, cheap and boundless fuel, mild climate, enterprising spirit and proximity to the Chinese market. Let me comment upon them, not boasting of our advantages in the least degree.

(1) *Nearness to China.*

It is a fact that China with 300,000,000 people, by conservative estimation, has the greatest consuming power in the world and Japan is conveniently situated to meet the market demand, just as the commercial situation of Great Britain to the European continent. Japanese know Chinese customs and habits better than any other nations. They can master the Chinese language quicker than any other people. Besides this, they can get practically the cheapest freight. The following freight rates of cotton yarn show clearly the advantage of nearness:

FREIGHT RATES OF THE COTTON YARN.

Navigation.	Miles.	Freight per Ton.	Freight of One Ton per Mile.
Shanghai to Tentsin,	750	Yen 9.662=$4.83	Sen 1.288
Kobe to Tentsin,	1,015	" 6.900= 3.45	.680

(1 yen=50 cents of gold dollar; 1 sen=$\frac{1}{2}$ cent of gold dollar.)

As you know, Shanghai is the largest seaport of China and

practically all the cotton goods which enter China pass through that port, whence they go to the North and East by steamers. But Japanese mill owners have advantages to send their goods to North China directly, to secure cheaper freight.

Another advantage of the nearness to market is a quick execution of orders. For instance, to ship cotton goods from the Southern mills to China you must spend at least four weeks on account of long distance, but from Nagasaki to Shanghai we spend 30 to 40 hours only. It is true that business men desire quick execution of orders as the market prices always fluctuate, and Japan can fulfill their desire on account of the nearness. This is a great advantage Japanese manufacturers are enjoying.

(2) *Cheap Fuel.*

Japan has immense coal fields at a short distance from the centre of the cotton industry. The quality of the coal is not so good as American soft coal but its price is comparatively low. According to the latest report of the Cotton Spinners' Association of Japan, the prices of coal in the Japanese mills average $2.50 per ton in 1901, against $2.10 in 1900. I think this is cheaper than the price of coal in the South, where the mills are paying $2.50 to $3.50 per ton. The following table shows consumption of coal in the cotton mills in Japan compared with the total consumption:

Date.	Total Consumption.	Consumption in the Mills.
1898	——— ———	370,056 tons.
1897	4,058,233 tons.	241,791 "
1896	3,044,688 "	192,387 "
1895	2,667,952 "	156,616 "
1894	2,311,810 "	131,301 "

Although the consumption of coal in Japan has increased and the price, so far, also increased, it will be cheaper in the future, as the mines are applying the latest devices of mining and transportation. Beside this, if the coal fields in China are opened, the price of coal in Japan will go down on account of the competition.

(3) *Water Power.*

Japan is a mountainous country and has numerous rapid rivers, which afford vast water power. At the present time a few mills are already operated by this admirable water power, which amounted to 1,621 horse power in 1900. I am sure if they apply the latest system of the generators and the small motors in the mills, like the South, they have a great future for the development of electricity.

(4) *Intelligent and Willing Labor.*

Japan is densely populated and has plenty of intelligent and willing laborers, which makes the most happy relations between laborers and mill owners; especially the Japanese girl has remarkable cleverness and adaptability in the art of making fabrics, as she is trained by hand weaving.

Mr. JOSEPH M. WADE, the publisher of "Fabric and Fibre", and one of the best friends of Japan, said in his magazine, "Japan does not need our skill; they need our machinery and they will do the rest". It seems to me that is a fair judgment and I want to apply that compliment to Japanese laborers, who have wonderful faculty of adaptability.

(5) *Mild Climate and Black Current.*

Japan has a mild climate which reduces the cost of mill heating and they never need shut down on account of extremes of heat and cold. Beside this, the Black Current, which originates near Australia, runs along the northeastern coast of Japan, imparting moisture to the atmosphere, which gives the natural lustre to the yarn and the goods. The advantage at this point can compare proudly with Manchester, England, and New Bedford in the United States.

(6) *Enterprising Spirit.*

Japan, the so-called "Oriental Yankee Nation", has the enterprising spirit to venture into new business and to adopt the latest and best machinery. It is a universally known fact that

FIGURE 9.—QUARTERS OF THE SUPERINTENDENTS AND OVERSEERS, HIRANO COTTON MILLS.

FIGURE 10.—QUARTERS OF THE OPERATIVES, HIRANO COTTON MILLS.

FIGURE 11.—OVERSEERS' QUARTERS, HIRANO COTTON MILLS.

FIGURE 12.—DISPENSARY AND HOSPITAL OF THE HIRANO COTTON MILLS.

FIGURE 13.—THE SCHOOL FOR THE OPERATIVES, HIRANO COTTON MILLS.

FIGURE 14.—INTERIOR OF THE SCHOOL FOR THE OPERATIVES, HIRANO COTTON MILLS.

FIGURE 15.— LEARNING TO SEW AT THE SCHOOL FOR THE OPERATIVES. HIRANO COTTON MILLS.

FIGURE 16.— IN THE PLAY-GROUND, ORGAN AND VIOLIN, HIRANO COTTON MILLS.

they have wonderful adaptability and lack originality. I do not know if that is the best judgment or not, because it is too early to predict the characteristic of the young native of Japan which came in contact with Western nations only 30 years ago. It is, however, true that the Japanese people are not conservative and stubborn and are adopting latest system in everything.

(7) *Protection and Encouragement of the Government.*

All Japanese industry is in the stage of infancy, so that they are enjoying the substantial subsidy of the government. To convey raw material from Bombay they can secure cheaper freight. Beside this, we have all kinds of conveniences and protection of the government, and all people recognize the benefit of the protection as the industries are young.

(*c*) THE DISADVANTAGES OF THE JAPANESE MILLS.

It is a fact, however, that Japan has many disadvantages, which are great enough to offset their advantages. Let me frankly comment upon them to decide the economic future of Japan.

(1) *Rate of Interest.*

What Japan really needs is capital. Indeed, at this moment Japanese mills are suffering from the scarcity of money to finance their business. A great deal is said and written about the introduction of foreign capital, but so far they do not succeed, as the foreign capitalists are ignorant of the business condition of Japan and are afraid to invest their money.

It is a fact that all Japanese mills borrow money from the banks, paying over ten per cent. interest per annum, even on the best security. Consequently it is a very hard task to the mills to give satisfactory dividends to the shareholders, who naturally demand profit over current rate of interest. In this country the mill can sell their stocks above par if they give a dividend of four to six per cent. yearly, but in Japan it must be at least ten per cent. to sell their stocks at par.

When cotton mills started in Japan they made remarkable profits and satisfied shareholders, as there was no sharp competition, but the rapid expansion of the mills brought them to suffer over-production and they were obliged to procure an outlet for their surplus product under the serious competition in the domestic as well as in foreign markets, and the condition became such as to cause grave anxiety for the immediate future as the stock prices went down below par. This is because the rate of interest is too high.

Beside this, they cannot equip mills with the latest devices on account of high rate of interest. I will tell you the reason why. Last year the leading Japanese mill owners came over to this country to buy up-to-date looms, so-called "Northrop", made by the Draper Company. Most of them, however, gave up their desires, after careful study, simply because the prices of the new loom were unusually high. I talked with one of them regarding this loom. He said "'The Northrop' is the best labor-saving machine I have ever seen and the quality of production is better than that of the common loom, but the price is twice as much as the common." The question naturally arises whether the Northrop loom is more profitably operated in Japan where wages are low and rate of interest is high. So far as I have ascertained the majority of mill owners agree that they can equip their establishments more profitably with the common loom instead of the latest and best machinery. This is because our rate of interest is high.

(2) *Raw Cotton.*

According to statistics made by our government the total production of cotton in Japan is as follows:

Date.	Total Production of Unginned Cotton in Japan.
1892	104,873,483 lbs. = 209,747 bales of 500 lbs. net.
1894	104,774,925 " " 209,550 " " "
1895	87,404,742 " " 174,809 " " "
1896	61,850,508 " " 123,701 " " "
1897	60,868,775 " " 121,737 " " "

Japanese mills, however, consume mostly foreign cotton and the domestic cotton is of no use, as the staple is considerably short.

The amount of consumption as well as grade of cotton is very clearly shown by the following table, prepared by the Cotton Spinners' Association of Japan.

Countries.	1897.		1898.		1899.	
	No of Bales	Per Cent	No.of Bales	Per Cent.	No.of Bales	Per Cent.
East Indian Cotton,	323,362	62.57	367,402	56.98	476,234	63.71
Chinese "	90,170	17.45	54,550	8.47	33,792	4.52
American "	86,324	16.70	202,285	31.38	220,597	29.52
Anam & Saigon "	11,764	2.27	10,881	1.68	6,026	.81
Egyptian "	2,822	.55	5,881	.95	7,080	.95
Japanese, "	2,137	.41	849	.16	40	.01
Other Countries, "	234	.05	3,045	.38	3,593	.48
Total,	516,813	100.	644,893	100.	747,362	100.

From the above table it is readily seen that Japanese mills consume more Indian cotton than any other.

Although we have the protection of the government to import Bombay cotton, under the principle of the subsidy ships which enables the mill owners to get comparatively cheap freight, still, being far from Bombay, they must pay 12 rupees and 12 annas per ton from Bombay to Kobe. The following tables show exact details of the freights of Japan Mail Steamship Company and also the competition with Peninsular and Occident Steamship Company (see the appendix).

As for American cotton, they usually pay about five dollars per bale of 500 pounds, which is a higher freight than any other country pays for American cotton. Although we have a great demand for American cotton in the future, as we are beginning to make finer yarn, the freight for that cotton is a great check. I am sure the disadvantage in the matter of raw material is about large enough to offset the principal advantage.

I have, however, the information from Osaka that the Japanese Cotton Spinners' Association entrusted Mr. JINTARO INOUYE to conduct a trial planting of American upland cotton in Fukien.

He went to China last spring with two experts in farming who are to undertake the work under his directions. The places to be selected for the purpose are, Chuen-Chow, about 50 miles inland from Amoy. But there are different opinions about his success, as the Fukein is not the best part of China to raise cotton. They also believe that even if he got a good crop at first, the soil would not regenerate for the second year's crop. Even Japan has tried to raise American upland cotton, but has failed in spite of the fertility of the soil, which seems, therefore, not fitted for American cotton in the Orient.

(3) *Machinery and Supplies.*

Japan is also further away from the source whence machinery and supplies can be obtained.

As you know, all Japanese mills are equipped with English machinery. But now you Americans are showing us the latest mechanical devices; hereafter our cotton mills should say "Good-by" to England and turn their faces to your country where highly perfected machinery is made.

There is no need to say that Japan pays the highest freight for machinery.

I have been told by a manufacturer of machinery that freight of one loom from a northern city to Japan is about $15, where the freight to the South is only $4 or $5.

It is the universal opinion that any nation who has remarkable faculty of imitation might win other nations temporarily, but in the long run, the originator alone can enjoy the last and permanent victory. I think Japan is not an exception to this rule.

But there is a divided opinion as to whether the Japanese will remain in the future only imitators.

It is, however, a great disadvantage to import machinery from foreign countries, especially from a country of long distance.

(4) *Female Labor.*

When I was informed of the number of females in the cotton mills of the United States, I understood that it was just like our country, because a vast majority of mill operatives are female.

The following table shows the number of operatives in Japanese mills.

Sex.	1894.	1895.	1896.	1897.	1898.
Male,	8,229	9,650	11,394	9,933	16,183
Female,	26,923	31,140	36,087	35,059	50,620
Total,	35,152	40,790	47,481	44,992	66,803

As the preceding table shows, the number of females is almost four times that of males.

The great defect of the Japanese female operatives is marriage. As I stated before, the Japanese girl has generally artistic skill and if they have long experience they will be equal to the French Canadian or Southern workers, but unfortunately most of them, after spending four or five years in the factories, quit work and marry and never work in the mill again.

According to Mr. SHOJI'S "Cotton Industry of India," in Bombay the vast proportion of mill workers are men. The following statistic of 1898-1899 shows the number of persons employed in the mills in Bombay.

	Number of Persons Employed.
Male,	92,180
Female,	28,028
Children,	17,782
Minors,	10,107
Total,	148,097

In the above table the number of males far exceed the females. Consequently they work in the mills at least six or seven years and it is not a rare case in India to have mill workers who stay for 30 years in the same mills.

On account of the above facts I am safe in saying that the pressing need of Japanese mills is to increase the number of male operatives as much as possible. But owing to higher wages the mill owners do not venture to employ more males. This is another disadvantage of the Japanese mills.

(5) *Management of the Mills.*

Those at the head of the management in the Japanese mills can generally be classified into three parts.

(*a*) A professional man, lawyer, politician and local rich man, etc., who has in many cases no special experience in the mills or shops; but owing to their local influence, they sometimes occupy an important position.

They are called "Blind Signer" as they are ignorant about their business.

(*b*) The practical man who has the ability to a more or less degree; but they have no economical knowledge of the world. It is a favorite argument of practical men that book-knowledge is of no use in practical matters. The vast majority of the presidents belong to this class.

(*c*) College men who have knowledge of western theories are rarely promoted to the head of the mills after they get experience in the mills or shops.

The time will surely come when all Japanese mills will be managed systematically by educated people who are thoroughly competent for mill management. At the present time, however, their ability is not generally recognized and as they claim higher salary than practical men, they are not usually favorable to the shareholder.

In this country there are divided opinions about the college men, but in Japan so called "practical men" have no systematic head and are ignorant about the foreign countries. Beside this, changes of the treasurers, superintendents, engineers and overseers are so frequent that they do not stay in the mills for a long time. Of course there are many exceptional cases to this rule, but it is true that they change their position very often.

Some change to occupy higher and more responsible positions by the fair consent of the head, but there are many who resign on account of the ill-treatment of their directors or superior officers.

Since I came to this country I have met many mill managers in the North as well as in the South who have served in the mills

for a long while, and it was not a hard task to find a man who has been with the same mills for his life time.

I have, therefore, strong reason to believe that, if the American people could manage with their skill, the number of mill workers in Japan would be reduced at least to one-third and their profit will be unusually large.

In short, Japanese mills have many disadvantages when we compare with cotton mills in this country. I can, however, agree that some of the disadvantages are temporary and that there is a probability of overcoming them in the long run. Still they are large enough to offset their advantages at the present time.

(*d*) THE CONCLUSION. JAPAN AS THE MARKET OF COTTON GOODS OF THE UNITED STATES.

From the preceding statements you should be convinced that the advantages of Japanese cotton mills are very slight as well as temporary when we compare with your country which has vast stores of raw materials, skilful and intelligent labor, cheap capital and perfect machinery. Especially the South which is destined to become a cotton manufacturing centre of the world has many advantages over Japan.

But remember, gentlemen, I am not in any way a pessimist. I have confidence that Japanese cotton mills may excel the Bombay mills which are mostly operated by Hindoos, Parsees, Mohommedans and Hebrews, and that the requirements in Japan as well as other oriental countries in the line of cotton fabric, are large enough to absorb all products of our country.

Before concluding this short sketch of the Japanese cotton industry I would say that cotton manufacture in Japan will be improved in many ways if both the government and the leading men of the country encourage the trade. But there is no promise of a rapid growth in the future as they have just experienced over-production in the line of coarse yarn. I predict, therefore, that the future development of the Japanese industry will be slow but sure and that the number of establishments will decrease for the purpose of forming combinations for controlling

products and prices and reducing the expenses of management.

Finally I ask you, gentlemen, why do you not try to export your products to my country where English made goods are consumed to a great extent?

I know you are striving to promote the trade with China which is the largest market in the world, and that you were successful in displacing the English made goods in that market to a considerable extent.

But I do not know the reason why you neglect the "Island Empire of the East" which has 45,000,000 souls who wear cottons or silks almost exclusively.

Do you think Japan manufactures cotton goods for herself and does not need any foreign goods? No, indeed!

We have manufactured lower grades of yarn and little of cotton goods. At the same time we are importing English goods to a great extent.

Do you not think you can undersell the Manchester goods in Japan? I think if you can undersell the English made in China, you can also do the same with the finer yarn and lighter goods in Japan.

When I was in my country I saw a variety of English cotton yarn and goods in the commercial museums as well as in dry goods stores in the various cities.

But I never saw American goods except a few samples of heavy goods. This led me to think that the United States manufactured coarse goods only. It was, therefore, quite an astonishment to me to see the variety of fine goods in this country and it was beyond my expectation, and I am now inclined to believe that the United States which is the smartest advertising nation in the world is not the smartest advertiser in the Oriental market.

The pressing necessity of the American manufacturers is to secure the market for the finer grades of cotton goods, because all Oriental countries except Manchuria want finer yarn and lighter goods.

I would advise, therefore, that you send a special commissioner

to my country as well as to China to make investigation of the market.

I have never seen a consular report that has shown the sharp and practical mind that is necessary and any insight into the market. It is strange to say that although Japan has the warmest feeling of friendship toward this country and the people are greatly in favor of American products and ideas, alas! she is ignorant about the cotton goods of the United States, just as American mill owners are ignorant about the Japanese market.

We have a commercial museum attached to the college at which the samples of goods and devices of machinery are explained to the student and exhibited to the public.

To this museum the Germans send a dye-stuff; the pupil is asked "What is this?" he says "Dye-stuff." "Where can you get dye-stuffs?" He says "Germany." Manchester sends machinery that is exhibited there. The student is asked "Where can you get machinery?" and he says "Manchester." If you send your goods I am confident that when the student is asked "Where can you get the best cotton goods?" They will answer "America."

APPENDIX.

STATISTICS.

(1) *Labor and Its Compensation in Osaka.*

The following statistics made by Osaka perfecture at the end of last year show clearly the details of the ages of the laborers and its compensation in the various industries.

(a) The total number of the establishments of various forms in Osaka is 6,856.

(b) The total number of persons employed in the same establishments is as follows:

Male,	34,685
Female,	29,057
Total,	63,742

(c) Ages of Persons Employed.

	Male.	Female.
Under 10 years,	319	418
Over 10 "	1,278	1,402
" 13 "	3,028	4.031
" 16 "	6,211	8,953
" 21 "	6,812	6,303
" 25 "	7,647	3,734
" 30 "	5,781	2,383
" 40 "	2,647	1,350
" 50 "	962	483

It is said that most of the children under thirteen years are employed in the match factories, of which those under ten years of age have to give sixty per cent. to their factories, and those from ten to thirteen, thirty per cent.

(d) Wages Paid.

	Male.	Female.
Under 2½ cents,	690	232
" 3 "	203	206
" 3½ "	332	356
" 4 "	438	507
" 4½ "	364	666
" 5 "	1,054	1,341
" 6 "	1,229	2,337
" 7½ "	1,943	5,326
25 to 30 "	1,970	21
35 "	1,257	0
40 "	638	0
45 "	217	0
50 "	156	0
60 "	99	0
75 "	54	0

In the above table the laborers who get wages over twenty-five cents a day are entirely male, attending iron work, glass factory and brush shops, etc. It will also be noted that the vast proportion of the females who get under seven and a half cents a day are the mill operatives.

Statistics About Hand Weaving.

(1) THE NUMBER OF HAND LOOMS AND ITS OPERATIVES.

Date.	No. of Dwellings.	No. of Hand Looms.	Persons Attended.		
			Male.	Female.	Total.
1894	600,444	820,585	48,175	895,416	943,591
1895	660,409	949,123	57,850	985,016	1,042,866
1898	637,523	934,201	57,334	921,386	978,720
1897	665,356	947,134	54,119	987,110	1,031,229

It will be borne in mind that these looms are operated chiefly in the dwelling houses, and produce fabrics of silk, cotton, and cotton and silk mixed. It will also be noted that the number of hand looms as well as the number of weavers is increasing.

(2) THE PRODUCTS OF HAND LOOMS.

(a) Silk.

Date.	Textures for Clothing.		Obi (Wide Belt)	
	Product. (Pieces)	Value.	Product. (Pieces)	Value.
1893	6,860,559	$10,446,756	524,245	$262,123
1894	8,674,964	14,384,621	750,058	375,029
1895	8,925,983	20,531,597	805,480	402,740
1896	9,897,756	22,909,682	1,238,617	619,309
1897	11,248,510	27,483,938	1,282,710	641,355

(b) Cotton.

Date.	Texture for Clothing.		Obi (Wide Belt)	
	Product. (Pieces)	Value.	Product. (Pieces	Value.
1893	43,622,964	$10,845,962	1,212,329	$309,590
1894	49,504,948	13,220,377	1,533,980	363,408
1895	63,422,144	17,840,389	2,109,679	701,490
1896	70,195,593	19,044,545	1,300,270	495,506
1877	60,831,000	20,447,152	1,761,665	679,521

(c) Silk and Cotton Mixed.

Date.	Texture for Clothing.		Obi (Wide Belt)	
	Product. (Pieces)	Value.	Product. (Pieces)	Value.
1893	3,601,563	$2,711,408	1,540,383	$1,912,659
1894	3,761,017	2,710,266	1,958,671	1,413,298
1895	3,975,602	2,991,183	2,716,262	2,149,448
1896	4,383,047	3,087,204	2,246,068	1,479,491
1897	5,448,064	4,280,583	2,130,232	1

(d) Hemp and The Others.

Date.	Hemp.		The Others.	
	Product. (Pieces)	Value.	Product. (Pieces)	Value.
1893	1,865,412	$1,007,908	372,911	$625,811
1894	1,519,120	1,546,583	518,677	152,214
1895	1,861,766	1,010,734	193,962	164,169
1896	1,571,255	1,173,068	135,172	160,971
1897	4,252,623	2,219,004	496,261	193,412

P. O. S. S. Co.

Date.	Bombay to Shanghai Bombay to Japan.	Bombay to Hongkong.	Remarks.
Before Jan. 1893	17	6	11% Discount.
From Jan. 1893 to Feb. 1894	8	6	25% "
From Feb. 1894 to Mar. 1895	8	6	25% "
From April 1895 to June 1897	10	8	25% "

At the end of June, 1897, the competition with Japan Mail S. S. Co. stopped. Since then both companies adopted the same freight rate, though not the same discounts.

JAPAN MAIL S. S. Co.

Date.	Bombay and Japan.	Bombay and Shanghai.	Bombay and Hongkong.	Remarks.
From Jan. 1893 to Feb. 1894	17 Rupees.	11 Rupees.	8 Rupees.	5 R's. Dis. for Japan
From Feb. 1894 to Mar. 1895	17 "	6 "	4½ "	" " " "
From Apr. 1895 to June 1897	17 "	7 "	6 "	" " " "
After this date, the competition stopped.				
From July 1897 to June 1898	17 Rupees.	16 Rupees.	12 Rupees.	" " " "
From July 1898	17 "	18 "	14 "	25% for China. " " "

At the end of March, 1901, the Japan Mail Steam Ship Company arranged with the Cotton Spinners' Association of Japan to discount five rupees per ton of cotton for 100,000 bales and to pay 13.05 rupees per ton for another 250,000 bales and no discount, consequently Japan pays twelve rupees and twelve annas for one ton of Bombay cotton on an average.

The PRESIDENT. It is a matter of regret that we have not time to hear the whole of that paper. We will now proceed with the next paper. We are fortunate in having with us the superintendent of the Niagara Falls Power Company, Mr. PHILIP P. BARTON, whom I have the pleasure now of introducing to you. [Applause.]

THE PLANT OF THE NIAGARA FALLS POWER COMPANY.

PHILIP P. BARTON, Superintendent, Niagara Falls, N. Y.

To describe fully the plant of the Niagara Falls Power Company from the standpoint of any one of the many branches of engineering represented in it by notable achievements, would require much time, which I think can be more advantageously devoted to the inspection of the plant which you are presently to make. Detailed descriptions of many of its more important features may be found in published articles that are readily accessible,* and in the little pamphlet entitled "Niagara Falls Power; its Applications and Use on the Niagara Frontier," copies of which have been distributed, will be found a comprehensive, though brief, account of the plant as it stands today. This pamphlet also contains some account of the manifold applications that have already been made of developed and transmitted Niagara power which form an exhibit which, I am sure, must be impressive to the members of any association of manufacturers.

My purpose this morning is simply to attempt, as a preliminary to your visit of inspection, a few brief explanations intended

* See *Cassiers' Magazine*, "Niagara Power Number", 1895, for a series of comprehensive, descriptive and historical articles. The account of the electrical features is brought up to date by Mr. J. E. WOODBRIDGE in the *Electrical World* for January, 7, 1900, and in the *American Electrician* for January, 1901; and in the complete and exhaustive paper presented by Mr. L. B. STILLWELL at the Buffalo meeting of the American Institute of Electrical Engineers, August 23, 1901. See also a paper by Dr. COLEMAN SELLERS on "Some of the Mechanical Features of the Power Development at Niagara Falls" in Volume XIX of the Transactions of the American Society of Mechanical Engineers, and an article by Mr. H. W. BUCK on "Applications of Niagara Falls Power" in *Cassiers' Magazine* for May, 1901.

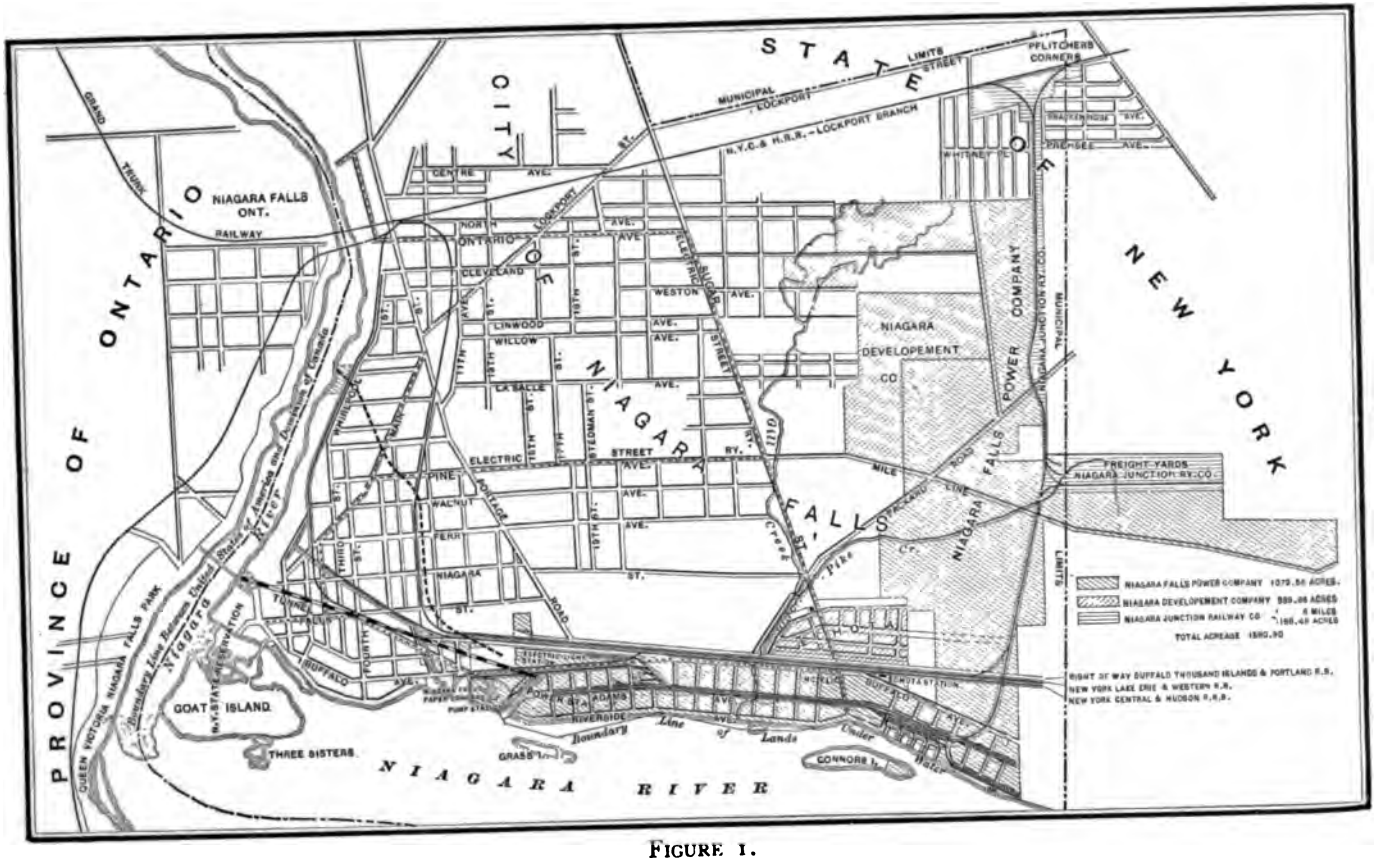

PROVINCE OF ONTARIO
STATE OF NEW YORK
NIAGARA FALLS ONT.
CITY OF NIAGARA FALLS
NIAGARA RIVER
GOAT ISLAND
THREE SISTERS
GRASS I.
CONNOR I.
NIAGARA DEVELOPEMENT CO
NIAGARA FALLS POWER COMPANY
FREIGHT YARDS NIAGARA JUNCTION RY. CO
PFLITCHERS CORNERS
MUNICIPAL LIMITS
LOCKPORT STREET
N.Y.C.& H.R.R.-LOCKPORT BRANCH
GRAND TRUNK RAILWAY
Boundary Line of Lands Under Water
NIAGARA FALLS POWER COMPANY 1079.56 ACRES.
NIAGARA DEVELOPEMENT COMPANY 559.06 ACRES
NIAGARA JUNCTION RAILWAY CO 6 MILES 186.48 ACRES
TOTAL ACREAGE 1825.90
RIGHT OF WAY BUFFALO THOUSAND ISLANDS & PORTLAND R.R.
NEW YORK LAKE ERIE & WESTERN R.R.
NEW YORK CENTRAL & HUDSON R.R.R.

FIGURE 1.

to aid you in forming a correct idea of the plant, the results already accomplished by it, and its future capabilities. To illustrate these explanations, I have had prepared a few lantern slides, which will now be shown.

The first view* to which your attention is invited represents a map of the territory in which the property of the Niagara Falls Power Company is located. The inlet canal or head-race, is shown at a point about one mile above the American Falls and the property of the Company immediately adjoins the upper limits of the New York State Reservation. The location of the discharge tunnel, or tail-race, is shown by the heavy dotted line. This tunnel, with its extension into the wheelpit of Power House No. 2, is 7,436 feet long; its average depth beneath the surface is 200 feet, and its outlet is close to the abutment of the upper steel arch bridge. The lands of the Power Company, shown by the shaded portions of the map, comprise an area of about 1,100 acres, including more than two miles of river frontage, all of which is available for factory sites. Through the property there has been constructed a belt line of railroad connecting each manufacturing industry, by means of a siding directly into the plant, with all the great trunk railway lines running through the city. Commodious docks have been provided affording ample facilities for water shipment to and from any port on the Great Lakes. The residence village of Echota (which will be referred to later) is also shown.

Figure No. 2 is a bird's-eye view and section of the installation, which shows clearly the means by which the water from the upper river is taken through the turbines and discharged through the tunnel into the lower river.

Figure No. 3 is a partial longitudinal section of the power house and wheelpit, showing generating units Nos. 1 and 2. The penstocks are 7½ feet in diameter. The vertical shafts connecting the turbines directly with the alternators are formed

* Figures Nos. 1, 2, 3, 4, 5, 10, 11, 12, 13, 16 and 19 are printed by permission from *Cassier's Magazine* and Figure No. 17 by permission of the Westinghouse Electric and Mfg. Co.

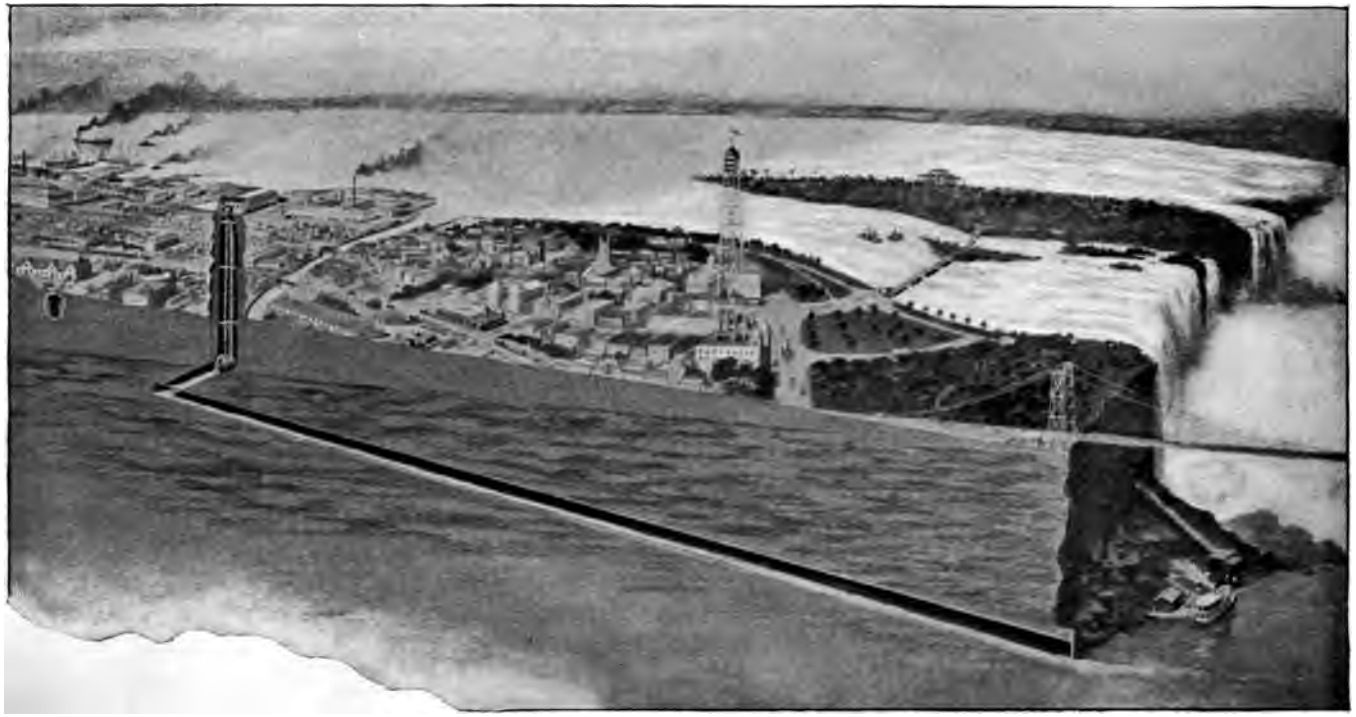


FIGURE 2.

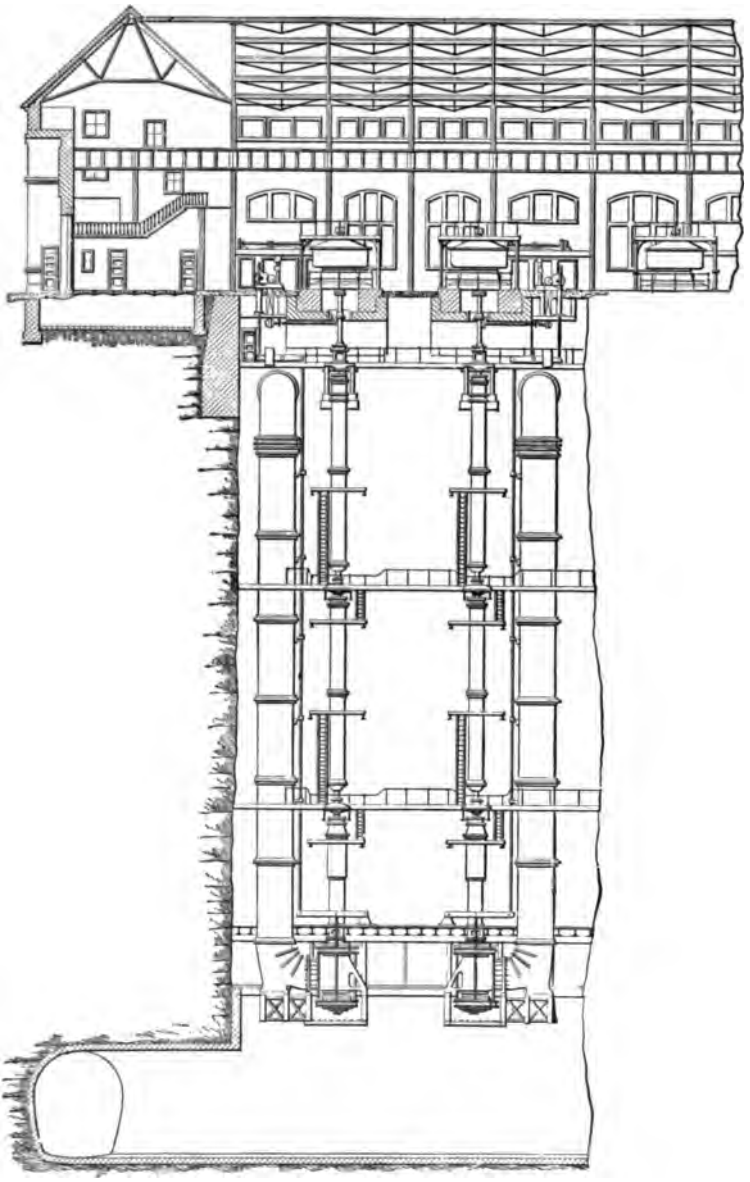


FIGURE 3.

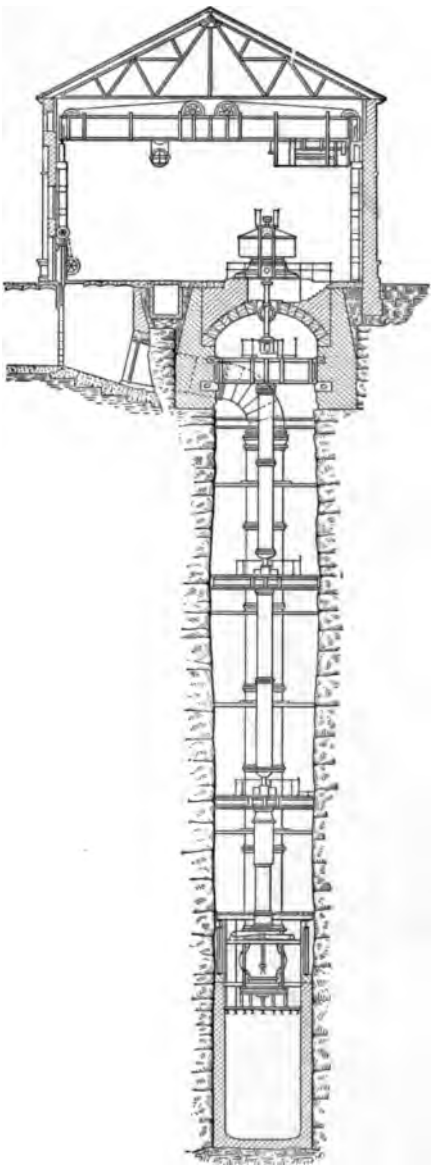


FIGURE 4.

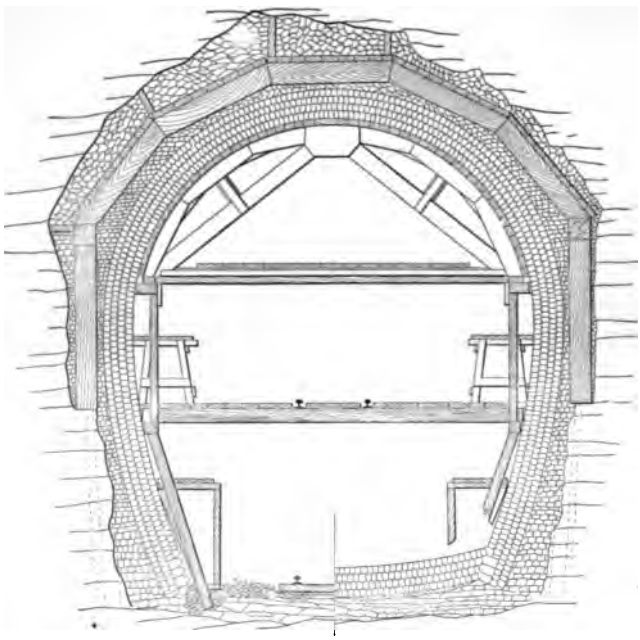
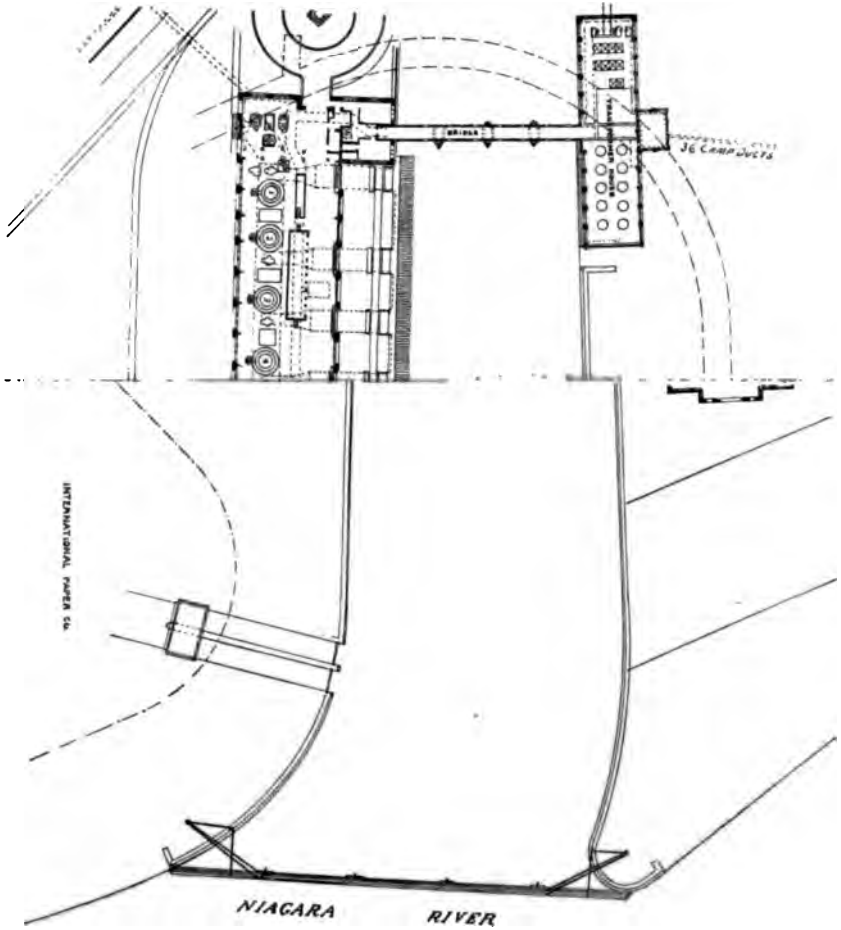


FIGURE 5.


INTERNATIONAL PAPER Co.
NIAGARA RIVER

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ASTOR, LENOX AND
TILDEN FOUNDATIONS.

of steel tubes 38 inches in diameter. Each shaft has two guide bearings, and at these points the diameter is reduced to 11 inches. There are two guide bearings in the turbine chamber and two in the alternator. The weight of the revolving parts, amounting to 150,000 pounds, is supported by the upward pressure of the water against a balance piston secured to the shaft in the upper part of the wheel case. Since this pressure varies somewhat on account of variations in the velocity of water in the penstock due to changes in load, a groove and collar thrust bearing has been provided immediately below the power house floor. The maximum pressure upon this bearing cannot exceed 3,000 pounds, but may reach this amount in either direction, upward or downward.

Figure No. 4 is a cross-section of the power house and wheel-pit, showing the inlet to one of the penstocks and the sluice gate working in the wall of the power house, by means of which water is admitted. The cable subway through the center of the power house is also shown.

Figure No. 5 is a cross-section of the tunnel. You will note that the section is the shape of a horseshoe, having a vertical diameter of 21 feet, the greatest horizontal diameter being 18 feet 10 inches. The tunnel is lined throughout with four courses of specially selected vitrified brick, of which 16,000,000 were used in its construction.

Figure No. 6 is a general plan of the power development, showing the inlet canal, Power House No. 1, and Power House No. 2 now in process of construction.

The inlet canal is about 1,200 feet long, 250 feet wide at its mouth, and has a depth of 12 feet.

In the plan of Power House No. 1, the position of the ten 5,000 horse power generators is indicated. Individual inlets to the penstocks are shown and also the positions of the governors on the power house floor. At the center of the building, grouped about the hydraulic elevator affording access to the wheelpit, are shown four exciter dynamos, each driven separately by its own turbine. These machines have a

capacity of 125 kilowatts each. Two main switchboards, each controlling the output of five alternators and each containing all the indicating, regulating and switching apparatus required for the purpose, are located as shown. The cables carrying the entire electrical output of the plant are installed in a subway under the power house floor. They pass through an extension of this subway over a bridge into the transformer house, where some of them supply the step-up transformers delivering power to the long distance transmission circuits, while others simply pass through the transformer plant into underground tunnels or conduits to transmit power to the local consumers.

The step-up transformer plant contains twenty 1,250 horse power air blast transformers, transforming the 2,200-volt two-phase current delivered to them by the alternators, into 22,000-volt three-phase current, which is transmitted by overhead lines to Buffalo and other distant points. Here are also located seven 2,500 horse power oil-insulated, water-cooled transformers raising the voltage to 11,000 volts for the purpose of transmission to the more distant local tenants. This transmission is accomplished by means of underground cables. In the north end of the power house may be seen what is known as the Railway Plant, consisting of three 500 horse power converters delivering 550-volt direct current to the local trolley lines.

The extension of the tunnel into the recently completed wheelpit of Power House No. 2 is indicated by the dotted lines. Power House No. 2, situated on the east side of the canal, will contain eleven 5,000 horse power generating units, six of which have already been contracted for and will be in operation early in the ensuing year. The present hydraulic development — canal and tunnel — has a capacity of 120,000 horse power.

Figure No. 7 shows the external appearance of the Power House, Transformer House and Connecting Bridge just before construction work on Wheelpit No. 2 was begun. Figures 8 and 9 are interior views of the Power House from which may be obtained a clear idea of the appearance of the alternators, switchboards, etc.

FIGURE 7.

FIGURE 8.

FIGURE 9.

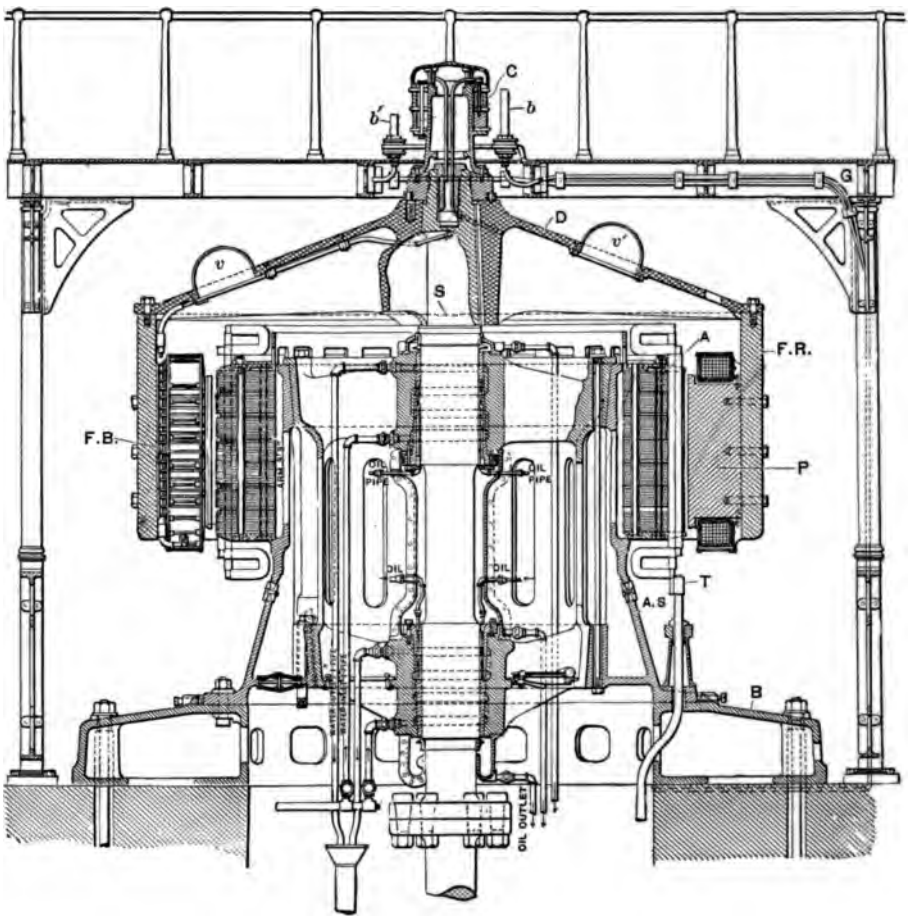


FIGURE 10.

FIGURE 11.

The time available will not permit much attention to detail, but the construction of the alternators is somewhat unusual and you will perhaps be interested in some of the details of construction. Figure No. 10 is a section of one of the alternators showing the stationary armature, the umbrella-shaped cast steel driver keyed to the shaft and forming the connection between it and the revolving field ring carrying the field magnets. The collector ring by means of which the exciting current is conveyed to the field magnets is shown at the top of the machine and access to it is obtained by means of the bridge. The current from the armature is taken off by stationary leads and is conveyed through cables under the power house floor to the switchboards. Figure No. 11 shows a view of the field ring forged under hydraulic pressure from a solid ingot of nickel steel. The outside diameter of the ring is 11 feet 7⅛ inches, the thickness of the ring being 5 inches. Figure No. 12 shows the cast steel driver to which the field ring is bolted in the assembled machine. Figure No. 13 shows the laminated iron core of the armature ready to receive the winding consisting of copper bars inserted in the slots shown.

Figure No. 14 shows a cross-section of the tunnel or subway originally constructed for a distance of 2,500 feet from the power house, to receive cables transmitting power to local tenants. For this style of subway there has been substituted in more recent additions to the underground distributing system an improved form of conduit, which is shown in Figure 15.

Figure No. 15 is a section of cable conduit consisting of 3½ inch terra cotta ducts laid in cement on a foundation of concrete and protected on both sides and on top by an ample thickness of concrete. Suitable manholes of ample dimensions are inserted at distances varying from 400 to 600 feet apart to facilitate the drawing in of cables.

Figure No. 16 is a map of the overhead lines forming the long distance distributing system. There are at present two separate pole lines: one carrying two 3-phase circuits of 350,000 c. m. copper cable, the other carrying one 3-phase

circuit of 500,000 c. m. aluminum cable — all working at a potential difference of 22,000 volts. The length of the overhead line between the step-up transformer house and the terminal house in Buffalo is approximately 22 miles. A branch line 14 miles long taps the main line in North Tonawanda to transmit power to Lockport. In the terminal house in Buffalo the current is reduced in pressure to 11,000 volts, and is distributed by underground cables to the various sub-stations indicated by the numerals, where it is further transformed and subdivided as may be required for the varied uses to which it has been put. Similar sub-stations are located in North Tonawanda and in Lockport. The maximum power at present delivered over these lines is 22,000 horse power, of which 5,000 horse power is used for the decorative lights of the Pan-American Exposition. The normal carrying capacity of each of the three circuits is 10,000 horse power.

Figure No. 17 is a diagrammatic representation of the method of transmitting power to each of the local and long distance tenants. The local distribution within a mile and one-half of the power house is effected by 2,200-volt, 2-phase current as delivered direct from the alternators. The diagram indicates the many forms into which this current has been transformed to meet the widely varying requirements of different classes of industry. The more distant local tenants are supplied from a sub-station receiving 3-phase power from the step-up transformer house at a pressure of 11,000 volts. The long distance tenants in Buffalo, Tonawanda and Lockport receive 3-phase power at a pressure of 22,000 volts.

Figure No. 18 shows the growth of the output of the plant since Aug. 26, 1895, when it began commercial operation, by means of a load curve for the same date in each of the six years. You will note that the present maximum load is well up to the capacity of the plant, allowing one unit for reserve in case of accident. The unusually high load factor of all the curves is worthy of remark, the average load in most of the curves being over 90 per cent. of the maximum. The curve

FIGURE 12.

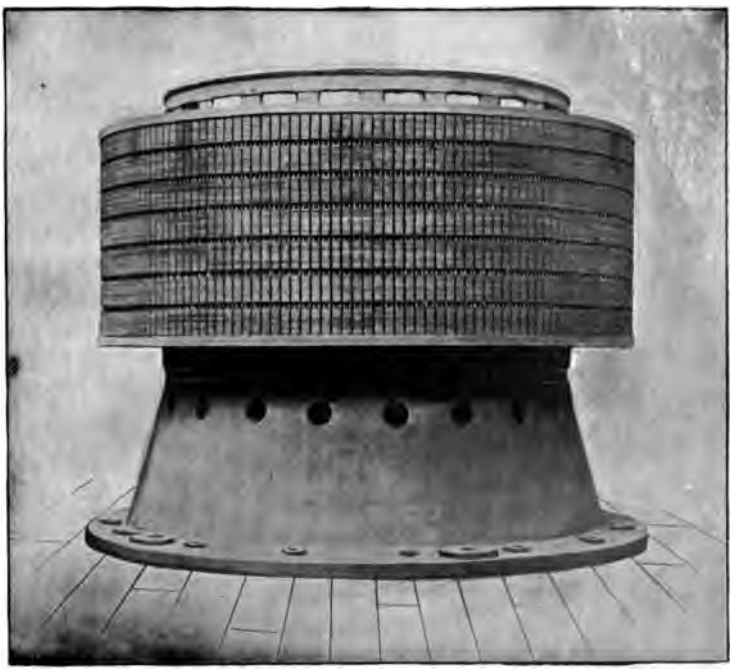


FIGURE 13.

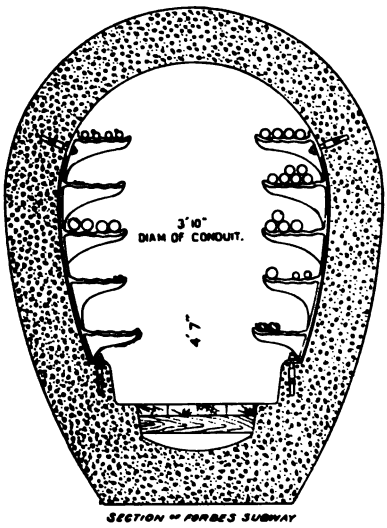


FIGURE 14.

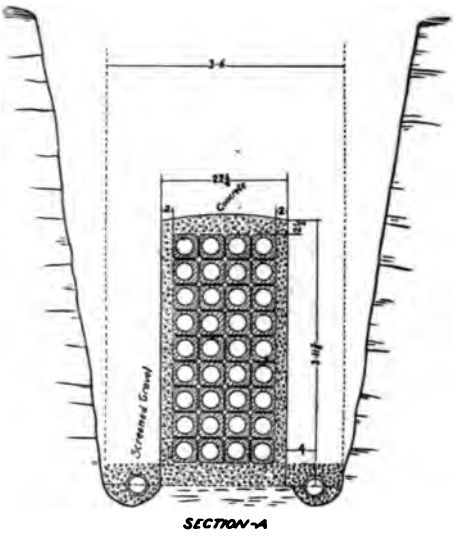


FIGURE 15.

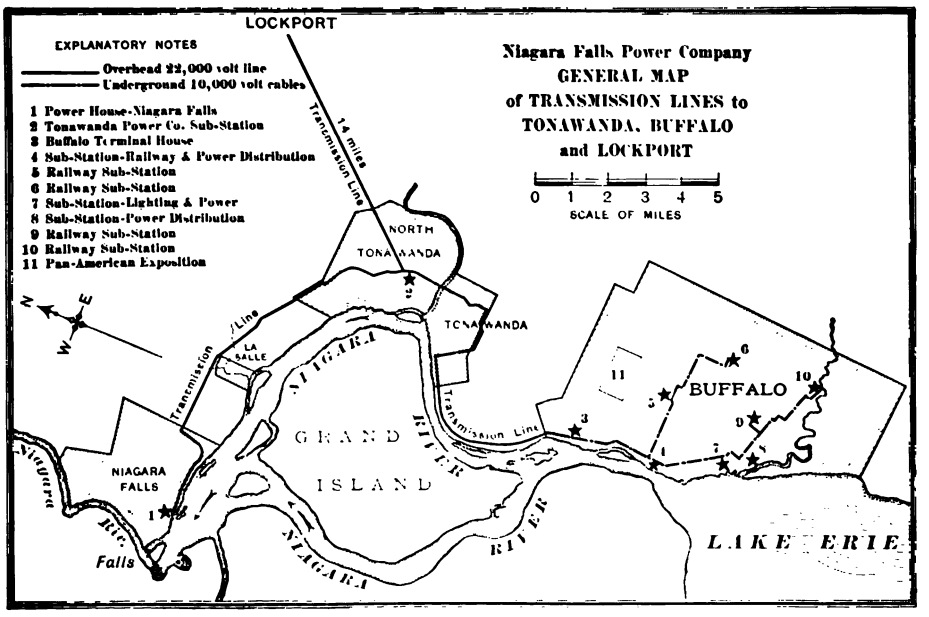
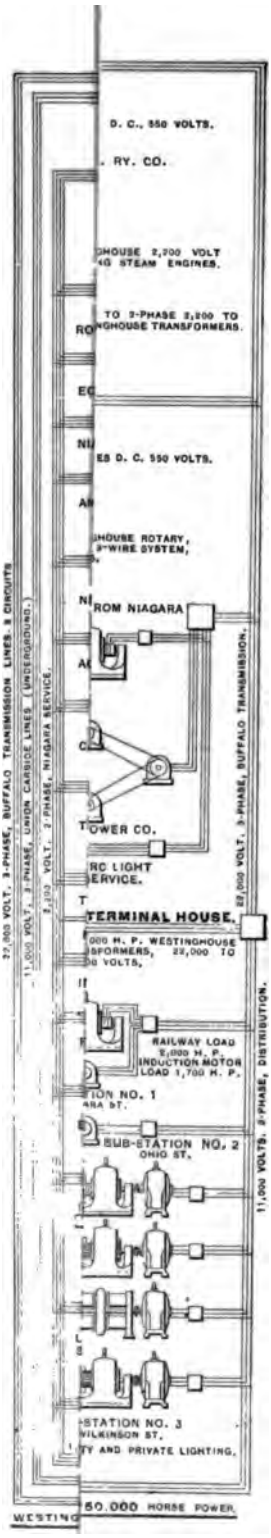
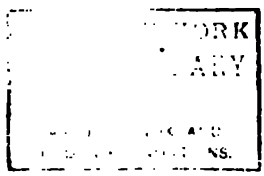


FIGURE 16.


D. C., 550 VOLTS.
RY. CO.
HOUSE 2,200 VOLT
G STEAM ENGINES.
TO 3-PHASE 2,200 TO
GHOUSE TRANSFORMERS.
ES D. C. 550 VOLTS.
HOUSE ROTARY,
3-WIRE SYSTEM,
ROM NIAGARA
OWER CO.
RC LIGHT
ERVICE.
TERMINAL HOUSE.
000 H. P. WESTINGHOUSE
SFORMERS, 22,000 TO
0 VOLTS.
RAILWAY LOAD
2,000 H. P.
INDUCTION MOTOR
LOAD 1,700 H. P.
ION NO. 1
ARA ST.
SUB-STATION NO. 2
OHIO ST.
STATION NO. 3
WILKINSON ST.
TY AND PRIVATE LIGHTING.
22,000 VOLT, 3-PHASE, BUFFALO TRANSMISSION LINES. 3 CIRCUITS
11,000 VOLT, 3-PHASE, UNION CARBIDE LINES. (UNDERGROUND.)
2,200 VOLT, 2-PHASE, NIAGARA SERVICE.
22,000 VOLT, 3-PHASE, BUFFALO TRANSMISSION.
11,000 VOLTS, 3-PHASE, DISTRIBUTION.
WESTING
50,000 HORSE POWER.


ORK
ARY

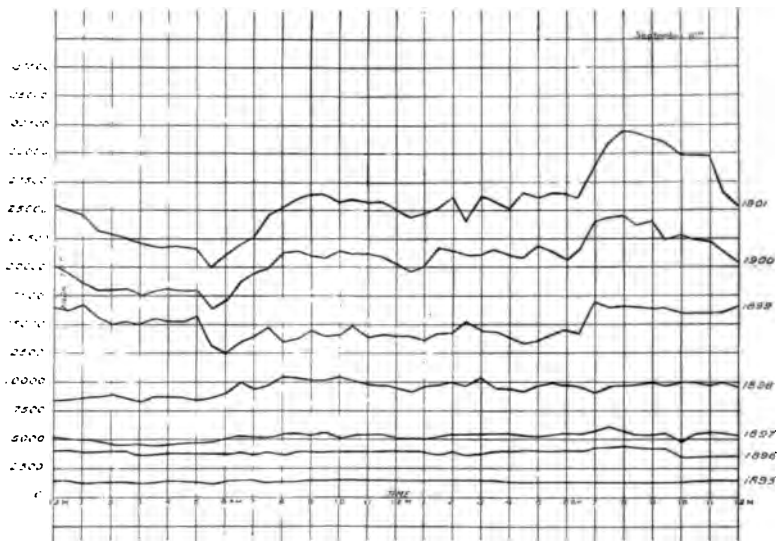


FIGURE 18.

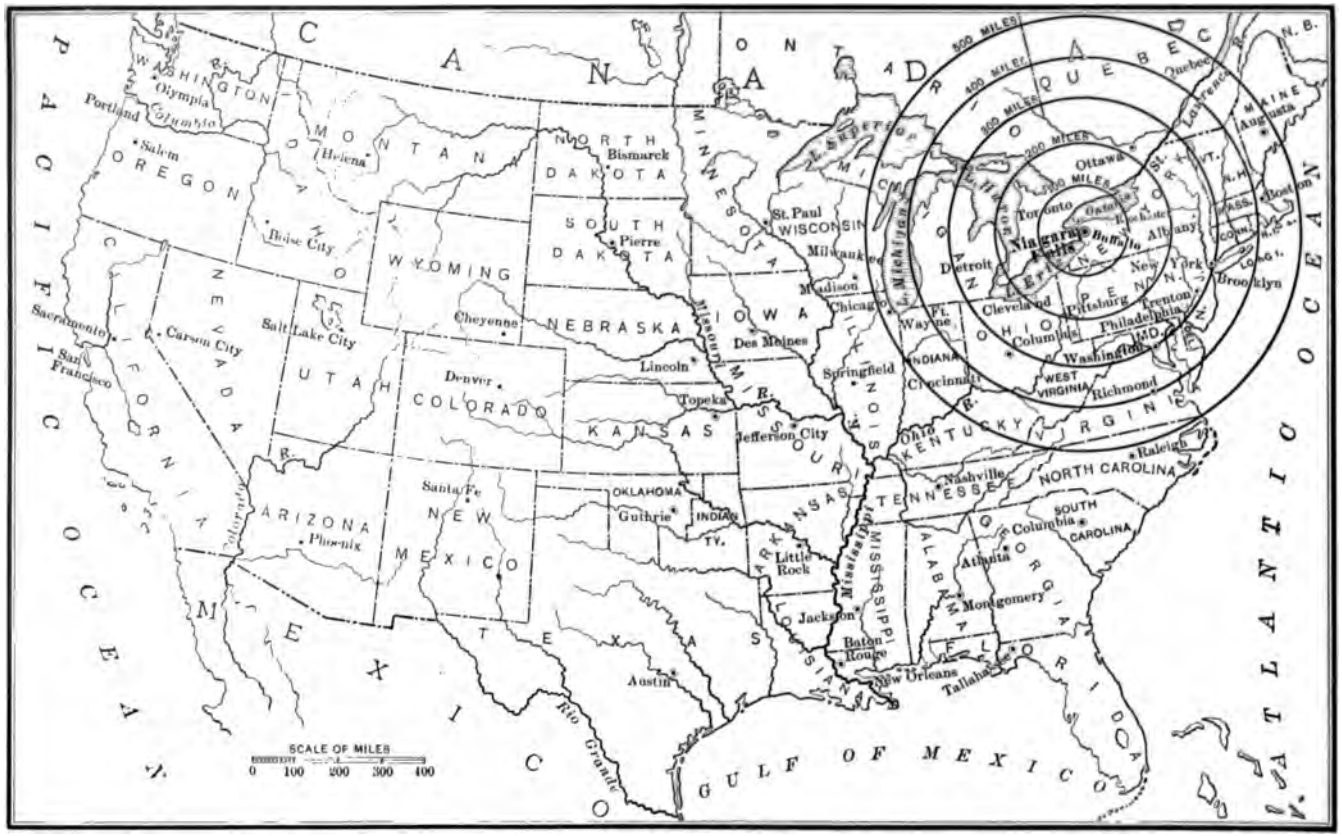

CANADA
ONTARIO
QUEBEC
MAINE
N. B.
Quebec
Augusta
Boston
Ottawa
Toronto
Niagara Falls
Buffalo
Albany
New York
Brooklyn
Detroit
Cleveland
Pittsburg
Trenton
Philadelphia
Columbus
Washington
Richmond
Raleigh
Nashville
Columbia
Atlanta
Montgomery
Tallahassee
New Orleans
Baton Rouge
Jackson
Little Rock
Austin
Guthrie
Santa Fe
Phoenix
Denver
Salt Lake City
Cheyenne
Pierre
Bismarck
Helena
Boise City
Olympia
Portland
Salem
Sacramento
San Francisco
Carson City
Lincoln
Topeka
Jefferson City
Des Moines
Madison
Chicago
Milwaukee
St. Paul
Springfield
Cincinnati
Ft. Wayne
Columbus
Washington
Richmond
Nashville
Columbia
Atlanta
Montgomery
Tallahassee
Jackson
Baton Rouge
Little Rock
Austin
Rio Grande
Colorado
Missouri R.
Ohio R.
Mississippi R.
L. Superior
L. Michigan
L. Huron
L. Erie
L. Ontario
L. Lawrence
L. Ontario
500 MILES
400 MILES
300 MILES
200 MILES
100 MILES
PACIFIC OCEAN
ATLANTIC OCEAN
GULF OF MEXICO
MEXICO
WASHINGTON
OREGON
CALIFORNIA
NEVADA
IDAHO
MONTANA
WYOMING
UTAH
COLORADO
ARIZONA
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
INDIAN TY.
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
ILLINOIS
MICHIGAN
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
SOUTH CAROLINA
NORTH CAROLINA
VIRGINIA
WEST VIRGINIA
PENN.
N. J.
MD.
N. Y.
VT.
N. H.
MASS.
CONN.
R. I.
LONG I.
SCALE OF MILES
0 100 200 300 400

FIGURE 19.

for the current year shows an unusual peak caused by the 5,000 horse power used for the Pan-American lights during the evening hours only.

In the year 1896, the total output of 83 of the largest central station plants in Great Britain was less than 47,000,000 kilowatt hours. At the present rate of working, the Niagara plant turns out more than 200,000,000 kilowatt hours per annum, or more than four times the aggregate output of all of the largest stations in Great Britain in 1896. This amount of power developed by steam engines using three pounds of coal per horse power hour would require the consumption of more than 800 tons of coal per day.

The industrial village of Echota has been built by the Niagara Development Co., owned and controlled by the Power Company, especially for employees and officials of tenant companies. This village contains 125 houses built on the most approved modern lines, with lawns, streets, and electric light service maintained without expense to tenants. Rentals are at figures easily within the reach of those for whom the homes are intended. A feature of this village is a model plant for the disposal of sewage.

Figure No. 19 is a map showing the advantages of Niagara Falls as a manufacturing centre. From this point circles have been drawn with radii of 100, 200, 300, 400 and 500 miles. Within the 500-mile circle is included more than one-fifth of the entire population of the United States. Within the 400 mile circle there are 350 cities each having a population of 5,000 people or more. Many of the great east and west trunk lines pass through Niagara Falls, and freight rates to the eastern markets are as low as those from many of the eastern manufacturing points to the eastern markets. To western markets the rates are, of course, much lower than from eastern manufacturing points.

I have tried to bring out a few of the points that might not be obvious in a brief inspection of the plant itself. In conclusion, I desire to say a word as to the practical results thus far attained in its brief history. Every municipal arc and incandes-

cent light in Buffalo, the Tonawandas, Lockport and Niagara Falls is supplied from it. All the trolley cars in these cities and their surrounding territory depend upon it for motive power. It has contributed in no small degree to the creation and development of a large number of important industries, and is already the centre of a prosperous, manufacturing community. The supply of power from it has not suffered total interruption since January, 1899, and during the current year about 25,000 horse power has been delivered locally twenty-four hours every day with only two interruptions aggregating less than thirty minutes.

The PRESIDENT. This finishes the morning session, and you will now be conducted immediately to the power house by special cars and meet again this evening at 8.30 at the hotel.

SECOND SESSION.

WEDNESDAY EVENING, SEPTEMBER 25, 1901.

The Association met in the parlor of the International Hotel at 8.30 P. M., President FISH in the chair.

The PRESIDENT. If you will come to order we will open the meeting. The first paper on the programme is The Cotton Fibre in Some of Its Phases, by Mr. HENRY G. KITTREDGE of Boston. Mr. KITTREDGE is unable to be present, and the paper will be read by Mr. WOODBURY.

THE COTTON FIBRE IN SOME OF ITS PHASES.

HENRY G. KITTREDGE, Boston, Mass.

The cotton fibre has been written about and discussed so many times, and in so many ways, and under so many aspects, that it would seem as if nothing new or entertaining could be said concerning it. Now, while all this is very largely true, it is sometimes profitable to repeat things well known, if thereby a more serviceable impression can be made of their usefulness. Still, the cotton fibre is not fully known as to its constituent parts, and new developments are now and then presented in its deportment under chemical and mechanical conditions.

The constitution of the thin and extremely delicate membrane or cuticle, that protects the outside of the fibre, has not yet been satisfactorily determined, more than it is known not to be cellulose, and therefore radically different from the rest of the fibre, unaffected by an ammoniacal solution of copper hydrate, which so readily dissolves the cellulose portion which it encases. This physical peculiarity of the fibre, though discovered nearly forty years ago, was not an accepted fact till after 1880. What part this outside membrane will play in any future discoveries within the realm of chemistry or physics, remains to be seen. It must have a usefulness of some kind, the same as all vegetable creations, and which, perhaps, already contributes a material value to the fibre for textile purposes, though undetermined, or which may be discovered in future investigations of the relation of fibres to the art of manufacturing. Under a microscopic amplification of 400 to 600 diameters, cotton fibres, under the action of an ammoniacal solution of cupric hydrate, can be readily

seen in the process of disintegration and dissolution, leaving this cuticle untouched and by itself. The addition of sulphuric acid causes a separation of the cellulose portion into a gelatinous mass, which, according to Prof. J. J. HUMMEL, on adding an iodine solution becomes colored blue, whereas the cuticle is colored yellow. This latter experiment we have never tried, though easily done, as the separated cuticle can be distinctly seen without the necessity of resorting to it. It has, however, this importance, of showing a difference in the constitution of the outer membrane from the interior of the fibre, in its deportment toward chemicals or dyes. How far this knowledge can be utilized in the science and art of dyeing is one of the things still left for laboratory research and dye house practice. There is much doubt whether or not this cuticle is removed in the process of bleaching.

Any knowledge of these occult characteristics of the cotton fibre, it may be thought, might as well remain where it is and always has been, so far as any practical value can be derived from it, as exemplified in the process of bleaching, which was accomplished as well in final results before as after its development to its present state of existence. Even L. TAILFER, in his recent work on bleaching, says that "It is not at all necessary to have extensive chemical knowledge in order to be a good bleacher," still he declares at the beginning of his first chapter that, "In order to establish a rational theory of bleaching it is necessary to have a complete knowledge of the elements which enter into the composition of fibres, what the elements are that can be removed or transformed, without injuring the soundness of the fabric, and what the chemical products are which bring about these modifications without attacking the parts of the fibres which it is desired to preserve intact." He then goes on and says that "The study of these questions is very delicate, and little progress has yet been made, but there is no question but it will yet be the cause of much progress in the bleaching industry. At the present time, experience, observation and inference — more than anything else — have demonstrated the

rules to be obeyed, or have indicated the series of treatments which fabrics should be made to undergo in order to bleach them." What TAILFER says in reference to bleaching applies with equal cogency to the manipulation and treatment of the cotton fibre in all the various processes through which it may pass in the course of manufacture. Experience, observation and inference, however important they may be as steps in scientific induction, are inconsistent if left to themselves, with the progressive age in which we live. There is much to be done before the art of manufacturing approximates that state of perfection which it is capable of attaining, and its success will lie in the knowledge of the small things that enter into its being. Though chlorine has been known as a valuable bleaching agent since 1785, when public attention was first called to it in this connection by M. BERTHOLLET, the theory of its action is not yet positively known, but is supposed to act as an oxidizing agent, with liberation of oxygen.

But no industry can rest on supposition and be progressive. It is impossible to regulate to a nicety chemical processes without knowing the nature and action of the chemicals used, and the nature and characteristics of the material to be acted upon. In the bleaching of cotton the object is to decolorize by removing the natural and artificial impurities associated with or attached to it, without impairing its strength or essential characteristics. How far each process should go, and when to stop, in attaining this object, cannot be ascertained for the best results, without a scientific knowledge of what takes place between chemicals and fibres.

Cotton fibres, in relation to their manufacture and uses, are finding new spheres of usefulness, as exemplified in their mercerization and in their conversion into what is popularly called "artificial silk". Notwithstanding that MERCER'S discovery of the action of caustic soda, caustic potash, sulphuric acid and chloride of zinc, at certain strengths and temperatures, upon cotton, has been known for more than fifty years, it is only within very few years that it has become familiar in the

art of manufacturing, and not till mechanical methods made it commercially practicable. What MERCER discovered and the effect of the mechanical devices that have been invented and applied, are among the unsolved problems today, relative to the actual changes that take place in the fibre acted upon. Very much is now purely theoretical, and processes and the means employed may change very materially when the actual facts are more fully known and understood. The chief object sought for by MERCER was to make cotton more receptive to coloring matter, producing deeper and more brilliant shades. In accomplishing this he effected a change in the chemical and physical structure of the fibre; a soda-cellulose being formed, in the first instance, turning to a hydrocellulose after washing and the elimination of the soda, and, in the second instance, becoming more or less cylindrical, with thicker walls. The weight is also increased 5 to 5½ per cent. This change in the physical features of the fibre can readily be seen and studied under the microscope, amplifying 400 to 600 diameters, which I have always found to be the most satisfactory magnification for the examination of either animal or vegetable fibres.

It is in this physical alteration of the fibre where much, if not most, of the commercial value of mercerization exists, in connection with the means that have been devised for preventing contraction in length. In practice, all the fibres in cotton yarn that is mercerized, and the same may be said of loose cotton that has been treated, are not changed to a cylindrical or rounded form, but many of them retain their natural spirality. The nearer, however, this cylindricity is obtained among all the fibres, the greater will be the lustre. The danger of carrying the process of mercerization to this extreme, is in weakening the strength of the fibres and consequently of the yarn, due to over action of the chemicals. In speaking of lustre, mechanical tension must always be considered in connection with the change of form from the spiral to the cylinder. The lustre on mercerized cotton fibres or yarn, is due to the same causes that make a

round, polished metal thread more lustrous than were it twisted, by presenting more points of direct reflection of light. As is well known, mercerized cotton, not held to its natural length, is dull and lusterless. This has been supposed to be due to the shrinking of the fibre, and a consequent wrinkling. But there are microscopists who dispute the existence or production of wrinkles by mercerization to a sufficent extent to materially disturb the smoothness of the surface of the fibre. A contraction, however, is admitted. Without discussing this point, my examinations have led me to a different conclusion, in that transverse wrinkles appear in minute but sufficient number to disturb the reflective uniformity of the fibre's surface, not in all fibres, but in many.

Cylindricity, smoothness of surface and parallel juxtaposition of fibres are essential for the best lustrous effects of a cotton thread. Cylindricity is produced by chemical means, smoothness by mechanical tension, and parallelism by the process of manufacture employed. The matter of subjecting cotton to tension at the time of mercerization is of much importance, as it can be overdone as well as underdone. There is much that is theoretical about this operation, at present, and much is left to inference as the result of observation and practice. The cotton fibre has the property belonging to all solids, that of elasticity of traction, and it is this property that is to be considered in the process now employed of stretching during mercerization. It would seem to be a physical truth that should the strain or tension exceed the force of elasticity inherent in the fibre, the latter would be seriously weakened. It is conceivable of mechanical appliances being operated in such a manner as to effect this excess of strain, but it should be remembered that, delicate as the cotton fibre appears, its tenacity, for its sectional area, is very great. It has been stated in the *Journal of the Society of Dyers and Colorists, England*, that unmercerized yarns stretched 11 per cent. of their length before breaking, and those mercerized without tension 17 per cent.; while those mercerized under tension showed the same stretch as untreated

yarn. These percentages are much higher than those given by Dr. J. HERZFELD, for yarns in their ordinary condition, in his work on the "Technical Testing of Yarns and Textile Fabrics," which are 4.5 to 5 per cent. for Nos. 20 to 30; 3.5 to 3.8 per cent. for Nos. 60 to 80; and 2 to 2.5 per cent. for Nos. 140 to 170. Length of staple and growth of cotton used are not stated nor any other particulars.

Cotton is the most valuable textile fibre that we have from the vegetable world, though of comparatively recent introduction in modern manufactures; the flax fibre preceeding it. The value of both of these fibres is dependent chiefly on their cellulose properties, which are capable of resisting the disintegrating agencies of oxygen and water, rendering them, in a measure, indestructible to the natural elements, as noted in the fabrics of antiquity. The destructibility of cotton in our manufactures is more to be feared from the mistreatment it may receive in the methods employed in manufacturing, not only mechanical but chemical.

It is a great satisfaction to note the attention that is being given to these points in the curriculum and practice of our textile schools, where the technology of textile fibres is studied, with special reference to their physical and chemical properties in their relation to the materials and agencies employed in the art of manufacturing. It would seem as if too much attention to industrial chemistry could not be given in the courses of instruction in our textile schools. Chemistry is of growing importance in textile manufacturing, and success is becoming more and more dependent upon it.

It would be well if our textile schools should devote some attention to such questions as the hydration of cotton, or, which would practically be the same, of cellulose. The reaction of iodine with a hydrate of cellulose has already been noted in the experiment recorded by Prof. HUMMEL, causing a blue coloration. This is but a suggestion of further experiments that might be carried on with possible profit. But the hydration of cotton has a close relation to an increased affinity for dyes, and

to the mechanical operations to which the fibre is subjected. This latter is recognized in the quite general use of methods for artificially humidifying the atmosphere of the factory. But the degree of humidity cannot be considered from a point of view in which the cotton fibre is regarded as a pure cellulose, as the spinning properties of cotton are affected, not a little, by the extraneous substances associated with them. The hydrated modification of the cotton fibre is not only an important factor in the spinning and weaving operations, but in the finishing operations for which too great dryness is not desired.

There is a great deal said about injury to the cotton fibre by compression as noted in some of the bales of commerce. Observations of various kinds, scientific and otherwise, have been conducted with all sorts of conclusions, but not one of them can be denominated conclusive. The cotton fibre is extremely pliable and tough, and it takes extremely hard usage to injure it. It is not as delicate as it looks. That the fibre is liable to injury by the harsh mechanical treatment it sometimes receives, admits of no question, but it has never been shown that a compression of fifty pounds to the cubic foot damages the fibre. A compression, of course, is conceivable which would irretrievably injure the fibre, but nothing of this kind need be feared from that found in any of the commercial bales of today. Fifty pounds, for instance, is but little more than one-half the absolute solidity of a cubic foot of cotton. In my tests of the specific gravity of cotton, I have found it to vary from 1.45 to 1.60, the variation being due, no doubt, to the presence of foreign substances,—but taking 1.50 as the commonly accepted average, an absolutely solid cubic foot of cotton would weigh 93½ pounds. The discovery of damaged fibres in a bale of cotton is by no means convincing that the damage was on account of compression. If there was any damage from this cause it would show a crushing effect, which would be very difficult to detect. Much has also been said about squeezing or pressing all the air out of a bale of cotton of 40 pounds, for example, to the cubic foot, leaving

nothing for fire to feed upon. I am inclined to think that people who talk in this manner do not know what they are talking about. As a matter of fact there is a lot of air in a bale of cotton of 40 pounds to the cubic foot, but, of course, more air in a bale of only 23½ pounds to the cubic foot.

The PRESIDENT. Gentlemen, you have heard the paper as read by the Secretary. This question of the mercerization of cotton fibre is one of growing importance. For a number of years we have known something of what they call mercerizing. In America it has only been within a comparatively short time that it has been done to any extent. I think there are one or two members in the room who know something of the subject in question, and we shall be glad to hear from them if they can favor us. Mr. MONTGOMERY, I think, knows as much about the subject as any of us.

Mr. J. R. MONTGOMERY. I do not know that I have anything to add to the paper which has just been read. Mr. KITTREDGE takes up the mercerizing of cotton from the scientific point of view, and I believe with him that there is still a great deal to be learned in regard to the mercerizing and the action of the chemicals upon the cotton fibre. We know that they are manufacturing now what is called artificial silk, which shows a very high lustre, even a higher lustre than silk, from cotton, made into a solution and passed through a very fine aperture and then spun. It has seemed to me that the time will come when cotton may be taken, and if every fibre in the cotton is thoroughly mercerized and has undergone the chemical and structural changes necessary to change the form of the fibre from a flat, irregular surface to cylindrical form, you will get then all the reflecting surface possible out of cotton. But until that time I believe that there is still room for improvement.

The PRESIDENT. We have another gentleman present as a guest of the Association, who is deeply interested in the subject of mercerization, and I would ask Mr. MADDOCKS to say a few works on this subject.

Mr. JOHN MADDOCKS, of Bradford, England. Mr. President, I should have been very glad indeed to have said something in reply to your invitation, but being a very much interested party in mercerization, and there being, as there is now, an action going on in which I am one of the plaintiffs, it might seem that whatever I might say about mercerization was said to have some effect upon those men that are infringing the patent, and therefore I must not speak from a selfish standpoint. But it may be of some interest to the members here to know that mercerization, as we know it today, has passed through many phases to bring it up to its present state of perfection. There have been, in fact, three distinct epochs. When MERCER discovered that caustic soda would produce the effect that he so much desired, namely, to get a hard spun cotton thread to take a deeper and a more regular dye, in those days they had not the machinery to keep the cloth, as they are able to keep it today, from shrinking unduly and irregularly. There was also this great drawback in MERCER'S day, that whereas he got — and what he most tried for was to get — a mordant which would enable him to dye a very tightly spun cloth which was then used for butchers' garments and to make it take an indigo blue dye — while he succeeded in that, he never succeeded in getting the cloth regular in width or regular in weight. It remained in that state for a great many years, and it is a strange thing — and this is a matter of history now — that when my children were going to school, along with them was a boy going to school at the same time, with whose father I was intimately acquainted; this boy had a knowledge of chemistry — at least, he had enough of chemistry, and he developed a taste in that direction, and ultimately he chose to become a student of chemistry in Manchester, succeeding so well that he entered as a servant in a large bleachery,

where he experimented; and knowing what MERCER had done, and knowing today that machinery was in a very much better state for doing what he thought could be done, namely, holding the cloth while it was being passed through the caustic soda out to width, he got such appliances that it did hold it out to width, and to his great delight he succeeded in keeping it to width while it was being washed; and after it was washed, he found that the cloth was actually improved in appearance; and as he described it in the patent which he let lapse, the cloth not only came out uninjured with regard to strength, but he found on examination that it was nearly 40 per cent. stronger, and that instead of being harmed in any way whatever, it was improved, having a better and a lustre-like appearance. The cloth was so much improved, and yet not nearly to the extent that it was afterwards improved by the Germans, because this young man took it around to all the principle users of cotton yarns and cotton cloth, but they did not see sufficient alteration in the finish of the cloth as to become enthusiastic about it enongh to put down the necessary machinery to carry through the operation which he told them it would have to go through to become as he had made these samples. He paid the royalty on the patent for three years, but having no encouragement whatever, he let it lapse.

Nothing further was done until a firm of German dyers, Thomas & Prevost, experimented with the object of mordanting the cloth that they were then treating. In Germany I should say that a great deal of cloth was made with a cotton warp and silk weft, and vice versa. Well, as you all know, in dyeing a mixed fabric of this kind, the silk would more readily take the dye than the cotton, so that a shocked appearance instead of a soft ground was the result. They wanted something to mordant the cotton with that would give a more regular and even appearance. They experimented, and in their experiments they held out the cloth to width, and one time when they were doing it they stretched it to more than its ordinary width and tore the cloth very badly. In that accident and through tearing that

cloth they discovered that by stretching the cloth more than its original width an extra silky lustre was produced. In fact, they were under the impression that the accident that this cloth met with and the extra treatment had somehow or other dissolved some part of the silk and it had shed itself onto the cotton and had so brightened it, until they took a knife and scraped the cotton fibre itself and found that the action had gone right through the fibre, and as much as they might scrape, this lustre remained there. So that it was not the solution of silk that had shed itself on to the cotton and so given it a temporary brightness, but the action of the soda had gone right through the fibre and it made it lustrous to the very core. They then tried again, and each experiment proved that with the extraordinary stretching, or with the extra stretching, they always produced what they called the silky lustre. Therefore they at once took out a patent for this, believing that they had made a discovery which was a very valuable one, and that is the discovery which people are acting upon today. And we all know this, that there has not been of late years anything that has gone to improve a cotton fabric more than the mercerization of cotton. I remember having a sample sent from this country of a small mixed cloth, silk one way and what seemed to be silk the other. This was about seven years ago. It was passed round the table in Bradford, where several merchants were sitting, and every one of us tried to make out what this was. We knew that the weft was silk, but we could not tell whether the warp was silk or what it was. We tried in the usual way to burn it, and there was no smell arising from it; it burned like cotton, but we could not imagine that such a lustre could ever be put upon cotton. However, that was the first time that I ever saw a mercerized cotton made into a fabric. It turned out in a very short time that the cloth was brought into Bradford and that it was made in Germany, and that this silk-like fabric was actually mercerized cotton.

From that time improvements have been made, and in the manufacture of fancy dress goods we all know that three ends

of mercerized cotton to one of silk give almost the same appearance that four ends of silk would do. Therefore mercerized cotton enters very largely into all fancy dress goods where silk is used, and it can be used, no doubt, to a much larger extent than it is today. But like other things, I am sorry to see this, that imitations for the sake of cheapness have immediately come into the market and misled the public into believing that they are buying mercerized goods when they are not. Mercerization is of more importance to the manufacturer of the East than any other invention of modern times, if they will only use it in the way they ought, namely, to do it exactly as the patent of Thomas & Prevost directs that they should do. It is in their trying to evade this patent that they are producing very bad results, which, instead of causing the public to favor it, is likely to make them feel that the goods offered to them as fair specimens of mercerization are not worth the difference in cost, whereas those manufacturers who are mercerizing yarn in the proper way find a ready sale for them and the public fully appreciates them, so that the demand will always be on the increase rather than the decrease. But the unwise policy of those who are trying to evade the patent is sure, if persisted in, to bring the process into disrepute. If you will only imitate our manufacturers of Bolton and the neighboring district in Lancashire by producing finer and better yarns, you will find ample work for every loom, and you will find that mercerization will be a great help. And if you will only go on spinning better and mercerizing better, the day will come, as Mr. MONTGOMERY says, when you will not be able to distinguish silk from cotton or cotton from silk, because you can make one as bright as the other.

The manufacturers of the East have it in their hands to have a prolonged life for their manufactures here, and they have no need to fear the South, because there is work enough for both. If the South makes the common and coarser goods, there will always be enough for you, if you keep improving and not deteriorating. But you have begun already to send out worse cloth because you want to evade paying the royalty. You can never

make a silk purse out of a sow's ear. You can never turn out good work unless you put good work into it. As our Japanese friend was saying, if America will only make the best goods that she is able to make, she will beat the world.

I am sorry to have taken up so much time, but I am very glad indeed if what I have said has been of any interest to the company. I would like for just a moment, if I may so digress, to do here what I had the opportunity of doing on the boat as we came across the Atlantic, after hearing the sad news or the assassination of your President. The President, Mr. FISH, this morning described that tragedy in such words that I am sure that I could not attempt to convey to your minds anything like what his words conveyed. But from the desire that a closer friendship may exist between the two English-speaking races and between our two peoples, I should like to say this, that when we heard of the tragedy last Saturday week in England, I do not think that there was a village, let alone a town, where a newspaper was distributed, but what a grief was felt at your loss and at that sad event which was next to the grief when our own old, dear Queen died. And if ever America wanted a proof of England's friendship, that proof was there, and I am glad to say that a great many American people were in England on that Saturday morning, and they for themselves could see that it was more than skin deep, that it went deeper down than that. One of our English papers, in speaking about the friendship existing between us, said that we must remember that we were bone of your bone, flesh of your flesh and blood of your blood, and that every fibre of our better natures vibrated and beat together on every occasion when any trial of this kind happened.

Well, I for one take the view that, sad as this event has been, there is something significant in it. I was very much struck with the President's prophetic words and especially with his prophetic policy in the speech that he made at Buffalo. Then with regard to the tragedy itself he said, "It is God's way"— I believe those were his words —"It is God's way"— and there-

fore he bowed to the inevitable. There is no doubt at all that the pure life that he lived, the domestic life that he lived and the example that he has shown to all the world in that home, the way in which he did his duty in that high office that he held, will never be forgotten. And when I read in the papers that he had died a comparatively poor man, I seemed to say from the bottom of my heart, "Thank God that is so," because he has proved to all the people that he was a thoroughly honest, conscientious man, and that he has done his duty from the love of duty, and that he has died the richest man in America; because any man can make money by the lowest instincts of his nature, but it takes a good and true man to make a reputation such as President McKINLEY has left. And there is no doubt about this, that it is God's way of showing this nation that there is something to aim for more than what we have been recently trying to aim for — that is, the acquisition of great wealth. All the wealth that is being made by those men who have deserved it by the outcome of their brain power, all the wealth that they have got, will never equal the wealth that that man has accumulated in the good name that he has left.

Ladies and gentlemen, we feel the same as you do about your President. We feel with you in every calamity of this kind. And all that I can say is this, that I hope that with all our privileges we may so use what God has given us in such great abundance that we may be enabled one day, instead of making implements of war, such as I saw in the Exposition today, to direct our increased intelligence and advanced civilization so that our two branches of the Anglo-Saxon race may seek to compete with each other not with those tools that are made to destroy human life, but that in the tool shops of our different countries we may rival each other in producing those things which will help in our manufactures, clothe our people better and make those luxuries which our civilization brings about, so that we may all grow better in that way and at no distant day make war impossible. We have this in our power. And therefore we trust that the union which has been cemented by this latest tragedy will grow,

and that it will be so steadfast that we shall never hear another word as long as we live other than that of the feeling of deepest sympathy with each other. [Applause.]

The PRESIDENT. After this very interesting talk from Mr. MADDOCKS I must say I do not feel at all guilty for having drawn him into it. When he began I did not know but I might have put him in a very uncomfortable position, as Mr. MADDOCKS, as he says, is an owner of the mercerizing patents in America which he is attempting to defend, and for us to consider the best way to mercerize, the best way to get at results, and perhaps conceive of some way in which we can get around his patents, it may be said that we are rubbing it in a little when we ask him to discuss the question with us.

Is there anything else to be said on this paper gentlemen? If not, we will take up the next paper on the programme, which is, The Round Bale at the Mill, by Mr. W. S. SOUTHWORTH of Lowell. Mr. SOUTHWORTH was not able to be present and Mr. WOODBURY will read the paper.

THE ROUND BALE AT THE MILL.

WM. S. SOUTHWORTH, Lowell, Mass.

The Massachusetts Cotton Mills at Lowell have used at various times during the last four years about fifty thousand bales of "round cotton", *i.e.*, the round-lap bales of the American Cotton Co. The use of so considerable an amount has naturally turned the attention of the managers of the mills, first to the making of various experiments to test how far the claims of superiority made for this form of bale were justified practically; and, second, to the devising of suitable mechanical means of opening, mixing and distributing the cotton to the feed boxes.

I give the following results of experiments made, with as little of comment or explanation as possible. They are not selected statements, but cover all the tests made; had there been any thought in my mind of future publication, I should doubtless have been at more pains to repeat and amplify them.

COMPARISONS OF TARE, ROUND-LAP VS. SQUARE BALE.

Dec. 1897.	30 round bales, gross	12,643 lbs.;	tare	148½ lbs.,	1.17%
	40 square " "	20,715 "	"	892¼ "	4.31%
April, 1900.	Gross weight, (round)	4,518 lbs.;	tare	34½ lbs.,	0.76%
	" " (square)	4,850 "	"	201¾ "	4.16%

The next comparison is on a larger scale, and covers other matters as well as tare:

Feb. 1901. 200 round bales; invoice weight, 52,627 lbs.; re-weight 52,652 lbs.; 25 lbs. gain.

100 square bales; invoice weight, 53,589 lbs.; re-weight 53,107 lbs.; 482 lbs. loss.

Tare on round bales, 437 lbs., or 0.83%
" " square " 2,070½ " " 3.90%

Value of round bale sacks, $3.82
" " square bale sacks and hoops, 12.12

A higher price for the round bale covering could probably now be obtained. Assuming for the sake of comparison that the price of the cotton was ten cents per pound in each case:—

Net lint from round bales cost, 10.072 cents per lb.
" " " square " " 10.476 " " "

Difference favoring round bales, 0.404 " " "

Two comparisons have been made to show the relative amount of moisture. One bale of each kind was taken, at random; the net weight was ascertained, and the cotton was then thrown loosely into bags, which remained in the opening room undisturbed for ten days before re-weighing. The loss by drying out was:—

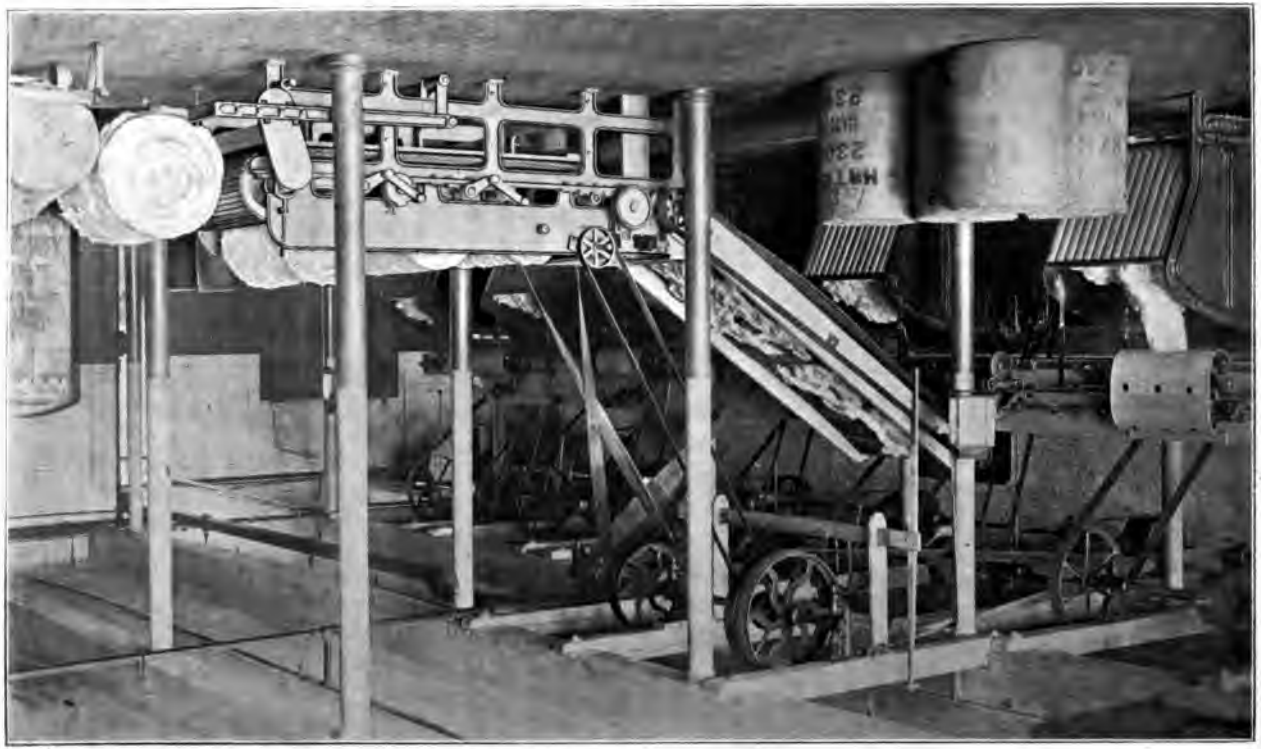
January, 1900, round cotton, 1.27%; square, 2.28%
March, 1901, " " 1.21%; " 2.52%

Of course this comparison is on too small a scale to justify definite conclusions; but those who have travelled in the cotton country will be most likely to accept the results as within the truth,—having seen for themselves the prevailing custom of exposing to the weather indefinitely the large soft bales turned out by the ordinary gin.

If these percentages of shrinkage are applied to the two lots of cotton compared in the experiment of last February, we obtain a corrected cost, using the assumed original price, as follows:

Net lint from round bales, dry, cost 10.198 cents per lb.
" " " square " " " 10.734 " " "

Difference favoring round bales, 0.536 " " "



As bearing on the question of storage space occupied, and of strength required in store-house structures, I will say that I have, without much effort, piled round bales in such a manner as to put 24,307 pounds weight into 900 cubic feet, measuring "over all". I calculate that a load of 225 pounds per square foot could be put upon the floor of a store-house, given 8½ feet clear height.

To present more clearly the method used for handling round bales in the opening room, I provide a photograph showing a portion of one of the rooms at the Massachusetts Mills. The unrolling machine was devised and patented by Messrs. BOSCA and BENNER, in my employ, and is built by the Kitson Machine Company. A bale is brought on a truck to the rear of the machine, the sacking is stripped off, and the bale is rolled upon the lifter, which, upon the moving of a clutch lever, raises it so that it rolls forward upon the travelling apron, which is slack enough to let the weight of the bale be mainly supported by two of the drums underneath. When a second bale is ready, another clutch is operated to lift and carry forward the first bale, and so on, until three bales are unrolling at once. The sheet or bat is broken up by drawing rollers into ragged pieces generally about a foot wide.

To this machine we have added an inclined apron, and a series of horizontal aprons for carrying the cotton directly to any one of the eight feed boxes in the room, only five of which could be shown in the photograph. The horizontal aprons are in different planes, one above another, overlapping a little at the ends; and the direction of motion of any of them is reversible by means of such a friction clutch as is commonly furnished with a lathe.

As this distributing apparatus has been completed only recently, I am not able to say positively from experience what, if any, economy of labor is secured by its use. I think, however, that three men could do all the work of opening and feeding for a row of twelve lappers.

The PRESIDENT. You have heard the paper, gentlemen; it would seem as if there ought to be some discussion aroused. I know a great many of us have tried the round bale, and a great many reports have been made for and against its use. Mr. TRUESDELL, can you not give us some particular information on the subject?

Mr. OSCAR B. TRUESDELL. In using the American Cotton Co.'s "Roundlap Bale", there is certainly a saving to the purchaser, not only in tare, reweights, and shrinkage, as shown by Mr. SOUTHWORTH'S paper, but in the picker waste, sand and not accounted for. This "not accounted for" every superintendent knows is a "thorn in the flesh", when making up his six months' accounts.

In tests that I have made at different mills, using the same grade of cotton in square and round bales, I have found from

5 square bales,	gross wt.	2,432	lbs.,	finished laps,	2,148	lbs.,	=88.32%
9 round	"	"	"	2440½	"	"	"	2,313	"	=94.78
3 square	"	"	"	1,610	"	"	"	1,400	"	=86.95%
5 round	"	"	"	1,387	"	"	"	1,315	"	=94.81
3 square	"	"	"	1,070	"	"	"	924	"	=86.35%
5 round	"	"	"	1,196	"	"	"	1,123	"	=93.90
2 square	"	"	"	1,061¾	"	"	"	959¼	"	=90.35%
4 round	"	"	"	1,036	"	"	"	980¾	"	=94.67

Mr. JOHN E. PREST. Mr. President, I would like to ask Mr. TRUESDELL where the difference comes in in the picker waste between the round and the square bale. What has that to do with picker waste, whether it is round or square, and both the same grade of cotton?

Mr. OSCAR B. TRUESDELL. Because the method of putting up this cotton, passing it through the trunk system, cleans the cotton better than where it goes directly into a lint room and is taken from there and put into the square bale. The machines for rolling the round lap bale have about the same effect as the

cleaning process in the trunk system, so that it certainly takes out more of the picker waste, more of the sand and more of the dust. It comes from that more than anything else.

Mr. JOHN E. PREST. Don't you get it on the next machine?

Mr. OSCAR B. TRUESDELL. No, not if it is taken out. It is not there.

Mr. JOHN E. PREST. Both the same grade of cotton? You cannot get more from one than you can from the other.

Mr. OSCAR B. TRUESDELL. Yes, but if the picker waste and the dust are not in the cotton on the round bale you do not have to take it out.

Mr. JOHN E. PREST. You do not have to in a square bale any more than you do in the round bale.

Mr. CHARLES H. FISH. I think Mr. TRUESDELL'S idea of the process of making the round bale is, that it is a cleaning process, more so than the process of making a square bale. Is that it, Mr. TRUESDELL?

Mr. OSCAR B. TRUESDELL. That is the idea.

Mr. JOHN E. PREST. That is it; that explains itself.

Mr. JOEL SMITH. Mr. President, what advantage is it to the manufacturer to buy the round bale?

Mr. OSCAR B. TRUESDELL. You get your cotton in better condition; it comes to you better. There is certainly less tare. Where you get about five per cent. on the square bale, you get less than one per cent. on the round bale. Your cotton does not come with the bagging all torn up. The weights are marked on the cotton as it is put up, and you get exactly what you pay for. We claim that one per cent. of tare is all we have, and as

shown by Mr. SOUTHWORTH'S report, it is generally less than that.

Mr. JOEL SMITH. Yes, but the cotton factor charges the difference in the cotton.

Mr. OSCAR B. TRUESDELL. Yes, he charges, not all the difference, but part of it. The tests that I have made at different times show that we can get a larger per cent. of finished laps out of cotton put up in the round bale than we can out of the square bale. So that really the cotton is cheaper to buy in the round bale than it is in the square bale.

Mr. JOHN E. PREST. Mr. President, one point I would like to ask. Mr. TRUESDELL says there is more dirt in the square bale than in the round bale. I take it for granted, then, that the cotton in the round bale is of a higher grade than in the square bale. In the round bale you get a middling cotton and in the square bale you get a strict low to middling.

Mr. OSCAR B. TRUESDELL. No, the grade of cotton is the same, but we claim that we clean it better; we take out more of the sand.

Mr. JOHN E. PREST. You clean it before it is baled?

Mr. OSCAR B. TRUESDELL. Yes, sir.

Mr. JOHN E. PREST. So that makes a higher grade, does'nt it?

Mr. OSCAR B. TRUESDELL. Well, not a higher grade. We grade by leaf and sand.

Mr. JOHN E. PREST. Do you take it all out?

Mr. OSCAR B. TRUESDELL. We do not claim to take all the leaf out. We take all the sand out, or nearly all.

Mr. JOHN E. PREST. The cleaner you get your cotton the higher grade it is, isn't it?

Mr. OSCAR B. TRUESDELL. Yes.

Mr. JOEL SMITH. I have had very little experience in using round bales, but in what I have used I find about the difference that Mr. TRUESDELL speaks about. The factor charges you for that difference. Where is the manufacturer benefitted?

Mr. OSCAR B. TRUESDELL. Well, as I said before, it is this difference, that your cotton will certainly work better, and the sand and dust being taken out, why, you get more out of the cotton for what you pay for. You do not have your skrinkage on your weights. Square bales will shrink all the way from three to four pounds on each bale, won't they?

Mr. JOEL SMITH. Yes, sir. Well, the round bales shrink, too.

Mr. OSCAR B. TRUESDELL. We claim that you are going to pay for exactly what you get. We do not have any shrinkage. We do not want to have to take off from three to five pounds.

Mr. JOHN E. PREST. In reply to Mr. TRUESDELL and also to Mr. SMITH, I will say that I have used round and square bales and watched them. We do not get the tare from the round bale that we get from the square, but we pay for it; we pay for that difference; they charge more for it. There is not that saving that it seems on the surface. We have paid for that to start with. When we get through and sift it down, there is not so much saving as perhaps may appear, to start with.

Mr. OSCAR B. TRUESDELL. Well, there is some saving, isn't there, Mr. PREST?

Mr. JOHN E. PREST. That is right.

Mr. OSCAR B. TRUESDELL. We will take that little, then.

Mr. JOHN E. PREST. It is put up nicely, and all that sort of thing.

Mr. OSCAR B. TRUESDELL. Yes, sir.

Mr. JOHN E. PREST. And the manufacturer is paying for it. But it is so little sometimes that it is hard work to find it.

Mr. J. R. MONTGOMERY. I think very likely it might clear up the matter a little to the members present to know whether these comparisons are being made on the same grade of cotton and the same price of cotton.

Mr. OSCAR B. TRUESDELL. Well, the tests were made on the same grade of cotton, sir, without regard to price.

Mr. J. R. MONTGOMERY. That does not cover the point. That does not cover the point Mr. PREST raised. The point is, are the cottons charged up to the manufacturers at the same price, or are you making comparisons at two different prices?

Mr. OSCAR B. TRUESDELL. If I understand you, if the square bale cotton costs ten cents, why, a round bale cotton would cost say three-eighths of a cent more.

Mr. J. R. MONTGOMERY. Then you are charging for a different grade of cotton, as Mr. PREST says?

Mr. OSCAR B. TRUESDELL. No; for the same grade of cotton at the first cost we are charging more, because we are not selling you the hoops and the heavy bagging. We are selling you nothing but the light burlap.

Mr. J. R. MONTGOMERY. Then we will eliminate, for instance, the question of hoops and bagging, and get down to seeds and tare.

Mr. OSCAR B. TRUESDELL. Yes.

Mr. J. R. MONTGOMERY. So as to get it right down so we can understand the comparison. Are you making a comparison on cottons with the tare entirely out — tare disappeared? Is the grade of cotton at the cost value of bale the same that you are making your comparisons on?

Mr. OSCAR B. TRUESDELL. On these tests that I have made, you mean, by putting it through the picker?

Mr. J. R. MONTGOMERY. I am thinking more especially of these figures that are in this paper just read.

Mr. OSCAR B. TRUESDELL. These tests, of course, I do not know anything about. I have not seen the paper until recently. I do not think I understand exactly what you want to know on that.

Mr. J. R. MONTGOMERY. I am trying to get at the basis for comparison. To get such a basis for comparison we will take the cotton in the pile, before it is baled, either in the round or the square bale.

Mr. OSCAR B. TRUESDELL. Yes.

Mr. J. R. MONTGOMERY. Take from the same picking, the same field.

Mr. OSCAR B. TRUESDELL. Yes, the same grade.

Mr. J. R. MONTGOMERY. The same grade in every way.

Mr. OSCAR B. TRUESDELL. Yes.

Mr. J. R. MONTGOMERY. Now, those are charged up at the same price. Is it on that comparison that you make this gain in tare?

Mr. OSCAR B. TRUESDELL. Yes.

Mr. J. R. MONTGOMERY. And in the shrinkage?

Mr. OSCAR B. TRUESDELL. Yes.

Mr. CHARLES H. FISH. If I understand it rightly, Mr. TRUESDELL, in that case the cotton taken from the same pile, part of it shovelled off and going into a round bale is sold for 10⅜ cents, for instance; the other part is shovelled into a square bale and sold for 10 cents.

Mr. OSCAR B. TRUESDELL. Yes.

Mr. CHARLES H. FISH. So it is the same cotton in a way; it is the same cotton, but the basis —

Mr. J. R. MONTGOMERY. Yes, but you have eliminated three-eights cents worth of dirt and seed.

Mr. CHARLES H. FISH. True. That is the point exactly, that the basis upon which these figures were made, I suppose, is the round bale with its additional cost attached but with the seed eliminated.

Mr. J. R. MONTGOMERY. Well, your additional higher grade. It is a higher grade after eliminating these two?

Mr. CHARLES H. FISH. It is a cleaner cotton, yes; the same cotton, cleaner.

Mr. J. R. MONTGOMERY. And therefore a higher grade.

Mr. CHARLES H. FISH. Yes, if you wish to call it that.

Mr. J. R. MONTGOMERY. You have got to grade it on the dirt. The cleaner it is the higher the grade.

Mr. JOEL SMITH. Mr. President, I do not recognize any difference, only the cover of the bale; that we have to pay for.

Mr. CHARLES H. FISH. Well, it would seem as if this question of the round bale always brings up these two champions. There are those who say the round bale is all right and

those who say it is not all right; that is, those who say the square bale is better than the round bale. The makers of the round bale admitted a few years ago, when it first came into use, that the round bale was not perfect, but claimed that the difficulties which were spoken of in the unwinding of it or the handling of it, had been entirely done away with and that hereafter it was to be all right. Well, whether or not that early experience influences any of us — I say any of us, because I took issue against it at the start — or whether or not the old idea of the round bale as being an unhandy thing and a bad animal to handle does prejudice our opinions today is a question. I am inclined to think that it is a very close point whether the additional price which is charged for that cotton is gotten back by the mill, or whether the cotton grower and seller get most of it. It is to be regretted that Mr. SOUTHWORTH is not here to take part in the discussion, although I think that Mr. TRUESDELL may understand the situation as well as Mr. SOUTHWORTH, but not having written the paper he is not in position to take the same stand that he would if he had written the paper.

Mr. JOEL SMITH. Mr. President, I have no idea of entering into any discussion at all, but I have recently had some little experience with these bales and also with the Lowry bale, and it does not make a bit of difference to me which I use. The question in my mind is, where is the manufacturer benefited by using the round bale? That is the question I asked. They charge more for the cotton in comparison to the cover; that is all there is in it.

Mr. J. C. SMITH. Mr. President, we have had some experience at our mill with these round bales. Of course I speak of them as I find them. About the price of the cotton, I know that we bought that cotton just as cheap as you could buy the square bales at the same time, the going price, and we have used about 3,000 of them this year, and a good deal of what Mr. TRUESDELL says is true. I think there is a benefit; at least I

find it so anyway. Speaking of the dirt, sand and leaf I think there is less of it in these round bales, and as he says, I suppose the reason is, in going through the process of getting it into a round bale, it gets this dirt out of it. I see no other way. We made tests at our mill, and I am sure the result was in favor of the round bale. Then about the hoops and bagging. Now on a square bale, if I remember right, the hoops and bagging are something like 23 or 24 pounds, and on a pair of round bales, which are the same as one square bale, there are about three pounds of bagging. Mr. JOEL SMITH says that we pay more for it. Well, we did not pay more for it; I know that we paid the same price as we did for the square bale.

Mr. JOEL SMITH. The same grade?

Mr. J. C. SMITH. The same grade and the same staple. I speak of this as I find it.

Mr. CHARLES H. FISH. Is it not a fact, may I ask, that the balers, the makers of the round bale, advertise that they do charge a small increase over the same grade of cotton in the square bale? Is that not so, Mr. TRUESDELL?

Mr. OSCAR B. TRUESDELL. Yes.

Mr. CHARLES H. FISH. So if you did buy that cotton at the same price, you are a very good cotton buyer; you were very fortunate at that time. They do charge an additional amount for having that cotton put up in the round bale, and if you can catch them every time on that, I should do it.

Mr. J. C. SMITH. I believe that is the general opinion, that you do have to pay more, but I know in our case we did not. And I will say further that the only trouble we found with that bale was with the men that opened it. The men that open it do not like it as well as the square bale. But that does not cut any figure at all, and that is the only trouble we had. So far as

everything else goes, I think the round bale shows the favorable opinion — in my opinion, anyway.

Mr. CHARLES H. FISH. You will understand that I do not mean to imply that you did not pay the same for the round bale.

Mr. J. C. SMITH. I understand.

Mr. CHARLES H. FISH. I simply meant that the advertised rate is more for the round bale than for the square bale. I think if you can buy the round bale for the same money as the square bale, there is no question which of the two you ought to buy — no question about it. It is merely a question as to the advantages to offset the additional price which is usually paid. I think perhaps we will have to have another paper on the round bale at the next meeting and continue this discussion.

Now, if you please, we will go on to the next paper, Overworking of Cotton in the Card Room, by Mr. E. W. THOMAS of West Durham, N. C., an ex-president of the Association. Mr. THOMAS was unable to come to this convention and Mr. WOODBURY will please read the paper.

OVERWORKING OF COTTON IN THE CARD ROOM.

EDWARD W. THOMAS, West Durham, N. C.

This subject is one of all importance to the cotton mill manufacturer and ought to be given far more consideration than it has yet received. Confining ourselves strictly to the carding and roving processes, as well as to the picking, for we must start with certain well authenticated facts, one of which is this, that cotton yarn possesses when spun only about 25 per cent. of the strength that the individual fibres have before being operated upon at all. This fact has been fully determined by the experiments of Dr. BOWMAN and I think some others,

What percentage of this loss of strength ought to be charged to the picking, carding and roving processes and what to the spinning, I do not think has been fully determined, but it is safe to assume the larger share of the loss in strength is from the working of the picking and card room operations; nor as far as I know has the result been dissected, giving any specified amount of loss in strength as the result of the individual picking, carding, drawing or roving processes.

There are three specific objects to be obtained before the spinning process, and they are to thoroughly clean the cotton, to attenuate from the lap to the fine roving, and to produce evenness of work. The pickers and cards are allied to the first and second elements as specified, and the drawing frame processes of today are more for the process of evening than for attenuation, as was the case years ago. Roving machinery is clearly an attenuation process. Now, in which of these processes is the greater harm done to the cotton in its transit from

bale to roving? Taking first the picking machinery, and while we are apt to give ample machinery to all the other departments, we do not pay heed enough to the proper fitting up of our picker rooms, as to the number of machines to be used. It has been my experience that the greater share of manufacturers give but little heed to this; it seems to be the place where economy in cost of installation is paramount to the proper working of the cotton. Now, there seems to be no just reason for this, for it is a department where the most unskilled and least paid people are employed, and I think it is safe to assume that where too few machines and too low a labor cost per pound for the picking room is found, that following this will be found increased cost of labor on cards and more extensive repairs in the way of clothing; and that when you find a mill whose picking cost is high, you will find that item more than offset by less labor cost and a better running condition of the cards.

I do not wish to be understood as being an exponent of our present system of picking. I will acknowledge that our builders of picking machinery are giving us machinery of superior workmanship and have spent thousands upon thousands of dollars for evening devices and large amounts in perfecting; still we are unable to obtain perfectly uniform weights of laps, nor do we obtain laps of uniform density when comparison is made between the various square inches in a yard of lap. To illustrate more fully, take the case where the standard weight of a finisher picker lap is 12 ounces per yard, and taking a single yard of such a lap that weighs just 12 ounces, and imagine this one yard to be cut into 36 strips each one inch wide and, say, 40 inches long. Now weigh each of these 36 strips, which compose this single yard of lap, and would it surprise you to find that the extremes would vary 30 per cent? Now this variation shows just what is happening in feeding to the card. The sliver delivered by the doffer must necessarily vary just the same, practically, as it is received by the feed roll of the card, with the attenuation caused by the draft of the card.

It may be asked what this has to do with overworking of cot-

ton in the card room. The answer is this: that as a result of the unevenness of the card sliver we try to overcome it by increased processes in the card room, making additional operations and sets of weighted rolls through which the cotton is passed, and each and every succeeding operation weakens the fibre. To prove this quickly and conclusively, try running sliver through four or five processes of drawing, or even more, and you will find your sliver so weak or lifeless that it will break while drawing from the can.

Do we overwork cotton in the cards? The answer to this depends much on circumstances. On ordinary cottons I think the finisher picker lap ought to weigh between 11 and 13 ounces per yard. I believe a heavier lap than 13 ounces tends to fill the clothing and cannot be taken from the feed by the lickerin with uniformity. Not a great while ago I visited a mill where the lap was 18½ ounces per yard, and the clothing on the cards showed the result of this extreme weight as well as the looks of the carding. A test made by the writer some years ago at a mill where there were some Kelley speeders running, very fully convinced me that we used too many operations in our card-rooms. The so-called Kelley speeder had a wide roller beam, on which were three sets of drawing rolls, the design of the frame being to take finished drawing sliver at back and make fine roving on front. In the experiment referred to, cans of card sliver were used instead of drawing sliver, and made into number 4 hank roving, which was afterward run single on a warp spinning frame and made into number 28 yarn, the yarn being made without any doublings whatever between pickers and the yarn. The elasticity of this yarn as compared with yarn made from single carding, two processes of drawing, and three processes of roving machinery, was 34 per cent. higher and the breaking strength about 30 per cent. higher.

Now this was conclusive evidence that cotton as ordinarily worked is weakened very materially, and the experiment gave a result very much desired by weavers and that was the increased elasticity of warp yarns.

For a good many years a large and prosperous mill in New England has been making practically fine yarns for weaving, where there were no drawing frames in use. The question is, are drawing frames essential? If practically we could obtain even card sliver, and if we can do without drawing frames, would our yarn not be stronger under these conditions? I do not think there is any doubt about it. Practically all the doublings on drawing frames and roving machinery is designed in a great measure, if not wholly, to counteract unevenness at the start, viz, the finisher picker lap. While doublings are a necessity, under present conditions, cannot something be done to get even yarn without using so many operations in the card room? It would certainly seem that with a picker lap of practically uniform density, and the sliver frame card of uniform weight per yard, some of the processes now in vogue might be eliminated to the benefit of the yarn and also in decreased cost.

It is stated that some fine spinners on hard twisted yarns, have already abandoned the third process of drawing, and are producing more even and stronger yarn. I believe to obtain the best results in a mill and to retain as much of the original strength of the staple, is to remodel picking machinery; to obtain a more uniform lap in density; to have an evener on the card to correct such uneven weights as may be taken from doffer; to eliminate drawing processes; reduce doublings on roving machinery, so far as is possible. This subject is one of paramount importance to the manufacturer, and any improvements in cotton working machinery tending to give stronger and more elastic yarn should be fostered and encouraged. The writer is well aware that there is much in these suggestions that is debatable, and trusts there will be a full and free discussion. This country is gradually reaching a point where its growth of cotton will be practically spun and woven within its borders, and become the great distributing centre of manufactured cotton goods of the world. The increase in home consumption of cotton the last ten years was about 28 per cent; the Northern

mills *decreasing* from 2,027,362 bales in 1891 to 1,966,897 in 1901; the Southern mills increasing from 604,661 bales in 1891 to 1,621,931 in 1901. The value of the cotton crop in the seasons of 1900 and 1901 was $494,567,549 or $47.63 per bale. With every prospect in the future of our being the centre of manufacturing, should we not make effort to make the best and strongest yarns that can be made? The question is what can be done to produce those requirements.

Mr. JOHN E. PREST. Mr. President, this is a very important subject to all of us. I am very sorry that Mr. THOMAS could not be here to discuss this question and give us the points. I think if a gentleman who writes a paper of this kind were present to discuss the question our time would be spent to better advantage than to pass it over. There is a great deal in this paper to be discussed, very good points, and a great many questions might be asked relating to it, and we could no doubt get much valuable information from Mr. THOMAS if he were here.

Mr. CHARLES H. FISH. There is no question but that it is to be regretted that Mr. THOMAS is not here, because it is a very important subject, and he seems in this paper to take in a way a radical view of the situation. I noticed in the paper of Mr. KITTREDGE it is stated that "The cotton fibre is extremely pliable and tough, and it takes extremely hard usage to injure it. It is not as delicate as it looks." Then he adds: "That the fibre is liable to injury by the harsh mechanical treatment it sometimes receives admits of no question, but it has never been shown than a compression of 50 pounds to the cubic foot damages the fibre." As this paper was read, my mind went to the paper of Mr. KITTREDGE, where he gives the impression that

you cannot easily injure the cotton fibre. Mr. THOMAS seems to take the other view — that we are injuring it by the treatment which it receives in the best of our mills; that our process is wrong.

Mr. JOHN E. PREST. Those are points that came to my mind in reading the paper through. Perhaps Mr. THOMAS has discovered something that we have not found yet.

Mr. CHARLES H. FISH. I will say that I know of one mill which is well run, a mill which stands very well and makes unusually good cloth, where they have never used the process of drawing for years, and within two years they have put the apparatus in.

Mr. JOHN E. PREST. I think there are two or three cases in the country.

Mr. CHARLES H. FISH. Yes.

The PRESIDENT. We will now proceed to the reading by the Secretary in the absence of the author of the last paper of the evening, Cotton Waste, by Col. SAMUEL WEBBER of Charlestown, N. H.

COTTON WASTE.

SAMUEL WEBBER, Charlestown, N. H.
Honorary Member of the Association.

The amount and economical disposition of waste is one of the questions which always arises to trouble the cotton manufacturer, and one which has not appeared to any great extent in the discussions of this Association, and on which, it seems to me, a good deal of light might be thrown, and valuable information gained, if some of the active members of this body will give us the results of their experience at the present day with the improved modern machinery now in use, both as to the amount of waste made in the mill, in working cotton, and as to the most economical manner of disposing of it, whether by attempting to re-work a greater or less portion of it into their regular product, or by selling the whole of it to other manufacturers of coarser or different fabrics, into which it could be put to good advantage. Although it is a long time since I have practically handled the cotton fibre in a mill, and my views on the subject may be considered rather as a "back number," I am inclined to favor the latter mode of disposition, rather than that of returning it to the picker house to be mixed in with fresh cotton and worked into the regular goods of the mill, and my reasons for it are these: I believe that in passing through the beaters of the picker and the grip of the fluted rolls of the drawing frames and speeders, the spirality or convolutions of the fibre, are more or less injured, and that a second working of them will render them more smooth and slippery, and less fitted to go into even yarn

for any of the medium or finer fabrics. The flyings from the card are also liable to the objection that they are mainly of the shorter and imperfect fibres, and therefore not so suitable for perfect goods. When I was working cotton myself, double carding was in fashion for all but the coarsest numbers of yarn, and was largely used on them, and there was a great deal of waste from the finisher cards, as well as that from the drawing and slubbers, which seemed to be too good to be rejected and sold, which I sent back to the picker house, but in these days of single carding with the revolving flat card there is no such waste, and I believe that the quantity of card waste is very much reduced. During the time when I was at Portsmouth making spool cotton in 1864, I found that the best waste from the Egyptian and Sea Island cottons used for No. 60 to No. 120 worked in very well with Texas cotton for numbers from No. 14 to No. 40, but that from those numbers I had a good deal of waste, which was not of suitable character to re-work for sewing thread and I utilized it by putting in a dozen cards, with the necessary drawing and roving frames and a coarse mule, in a vacant wing, and spun all this into coarse hosiery yarn, which proved the most profitable part of the business, and left me very little of any great value to sell. Such a little independent plant is not always practicable, but it seems to me that many of our large mills on fine numbers might install one to advantage. I have always believed that there was a great deal of unnecessary waste made, and I know this to be a characteristic of the American people, from the forest and farm to the household and kitchen, and it universally attracts the attention of foreigners, who are carefully trained to more economical habits; and, when in my younger days I wondered at some of the evident waste I saw, it brought the answer that "cotton was cheap, and labor expensive, and it would not pay to save it." I did not believe in the philosophy of the excuse then, nor do I now, but of later years, as I have been going about the mills, measuring power, I have seen waste made in a way that appeared to me perfectly inexcusable. I have seen a fly frame tender deliberately strip

off the whole of the last layer of roving from a slubber bobbin, and throw it over her shoulder, to go into the waste basket, to save herself the trouble of coming round to the back of the frame again, to replace it, when it ran out properly a few minutes later, and this not once, but many times, with other instances of a similar character in different departments of the mill. Of course it was none of my business, but I mention it now, to show that the question of waste is an important one, and needs more attention than I think it generally receives. I am fully aware that in many mills it is very closely looked after.

While it is possible to re-work such waste as this from the roving frames, and most of the waste which is caused by "break downs" at the railway heads and drawing frames, that from the cards, should, I think, be entirely rejected; the strippings usually are, and I believe most of the flyings, which are probably to a large extent, short and imperfect fibres.

These imperfect and unripened fibres have been very fully discussed and illustrated at previous meetings of the Association, and I will only add that I once had an unpleasant experience with a lot of cotton which contained many of them, in the carding and spinning rooms, and later in life, when I was at the Manchester Print Works, with a lot of cloth into which some of these unripe fibres had been worked, as follows:

We had printed a number of pieces with a drab, or stone-colored ground, with black and red figures, and when the goods came from the dye house they were covered with fine, white specks, which had not taken color. The workmen called them "measly," and no one could account for them until we procured a powerful microscope, which showed each of these white specks to be a fibre of smooth, glossy, unripe cotton which had not absorbed the color in the dye-bath. We saved the goods for the market by reprinting them with a fine black "cover" which disguised and partially concealed the white specks, but it taught me a lesson about unripe cotton, and I believe such fibres constitute a large portion of the card flyings. I may have told this before, but it is worth repeating.

As I said at first, my opinions may not be of sufficiently recent date to be of much importance, but such as they are, I offer them as in favor of some other disposition of the necessary waste, than that of re-picking and re-carding it, to be worked into regular goods, for I believe that every operation tends to destroy the "spirality" or fluting of the fibre, and render it more slippery and less suitable to be spun into perfect yarn.

I offer them, to draw out the comments of the younger and more active members of the Association who are now engaged in producing a much finer class of fabrics than were made thirty years ago, and with the aid of improved machinery which should make much less waste. I believe that waste is saved by the introduction of the revolving flat card and the disuse of the railway head, taking the cotton direct from the card to the first drawing frame, for the railway was to my recollection, a great "waste producer," and also by the abolition of double carding, which seems to me to unnecessarily scrape and injure the fibre and to break and throw out a good deal of it as flyings, which was otherwise perfect. Much waste can be and probably now is saved by more careful attention on the part of the operatives, avoiding such instances as I have mentioned of throwing away the last layer on a speeder bobbin. There is also a recent invention which seems to me to be likely to be a great "waste-saver," and that is the introduction of the "round bale," wound directly from the gin, with its more perfect covering. Any one who has ever visited the cotton-growing districts of the South, and seen the old square bales, lying for days in puddles of wet red mud at some country railway station, can see at once the saving to be expected in this direction.

This is a matter, however, which is not in the province of the manufacturer, except so far as his influence may go, in favoring the new method of baling and insisting on receiving his cotton in good order, and not loaded down as I have found it, with seeds and dirt, shovelled in from the floor of the gin-house, nor as I once found (before the civil war, too,) with a cannon ball, and in another case with half a hickory cart axle, neither of

which would be likely to find their way into one of the new style of bales. A young friend of mine, now at the head of one of the large cotton enterprises of the day, asked me some years ago, how I made up my waste accounts, and said he could not make his come out to square with the pounds of cotton put in to the mill, and I told him he had forgotten the fine dirt, blown away by the picker fans, and the shrinkage by evaporation of the moisture in the exposed bales, which, together with what he had accounted for, would probably square it, but that, as KIPLING says, "is another story."

I hope some of the younger members of the Association will give us their views on the subject of "re-working waste," for I think it is well worth attention and discussion.

The PRESIDENT. You have heard the paper, gentlemen; is there anything to be said on this? It is another important question which ought to bring forth good discussion. I know myself that when I have worked cotton waste I wished I had not; when I did not work it, I wished I had. Nothing to be said on this paper? Then it is in order to adjourn until tomorrow morning at nine o'clock in this room.

The SECRETARY. There is for distribution a supply of pamphlets on the Niagara Falls Power House, which we visited this morning.

Mr. JOHN E. PREST. I make the motion that we adjourn until tomorrow morning at nine o'clock.

The motion to adjourn was put to vote and carried, and the President thereupon declared the session adjourned to Thursday morning, September 26, at 9 A. M.

THIRD SESSION.

THURSDAY MORNING, SEPTEMBER 26, 1901.

The Association met in the parlor of the International Hotel at 9 A. M., President FISH in the chair.

The PRESIDENT. We will now proceed, if you please, to the presentation of papers. The first paper on the programme is, Thread Boards and Guides, by LEWIS T. HOUGHTON of Worcester, Mass.

THREAD BOARDS AND GUIDES.

LEWIS T. HOUGHTON, Worcester, Mass.

Perhaps this subject of thread boards and guides has received so much of your attention in the past that to many of you it will be like threshing of old straw, but the fact of the straw having been threshed demonstrates that the grain is valuable and with your kind consideration for a few moments I will endeavor to find some few grains of interest that there may be left in the matter.

In looking for information in regard to thread guides one thing which has interested me very much is the wide difference in opinion which prevails among the expert cotton spinners in regard to the shape for the eye of thread guides. A manufacturer of thread guides recently made the remark that there were as many different thread guides as there were superintendents of cotton mills (very likely he exaggerated a little.) The principal point of disagreement that I have found is that one wants a straight back for the guide so that the thread will vibrate and not wear a groove in the guide. It is also claimed that this vibrating of the thread permits the twist to run up to the "bite of the roll" better, while others claim that these advantages are offset many times over by the extra breakage of travellers and the more and uneven wear of the rings caused by this vibrating thread. It would seem that a matter like this could be and should be settled by so exhaustive a trial of the different shaped guides that there could never be any more doubt as to which was the best shape or else demonstrate that the shape was

immaterial. With only one standard guide to make, their cost would be less to manufacture.

In an article on the Management of the Spinning Room, in the only reference to thread guides it states that the guide should deliver the thread EXACTLY over the center of the spindle. This requires a very fine adjustment for the thread guide. The only method of adjusting the guide in the past (of which I have any knowledge) is for the guide to be screwed into a wooden block, which has proved very unsatisfactory and is the reason for some of the different size thread guides, for as the guide becomes loose in the thread board another guide of larger sized wire is used, or the hole is plugged and glued until the thread board is put out of business.

When the Pontiac Guide is used it certainly should be accurately adjusted and also held solidly in place or the kink arrester will either break the thread when it is running all right or it will fail to catch the broken end of thread when an unavoidable break occurs and a series of spindles may be put out of commission. I recently saw a practical illustration of this while watching the work of a spinning frame. A thread broke, which was instantly followed by the five threads to the left in quick succession. An investigation showed that the guide on No. 1 spindle was turned down so far that the kink arrester end was almost in line with the center of spindle, which was the cause of the first break (as the thread broke repeatedly in trying to piece the end without moving the guide); the next four guides the kink arresters were turned out so nearly horizontal that they failed to catch the ends as they broke. The guide over the sixth spindle was in its proper position and the break was arrested. Here were six spindles stopped work for the fault of an improperly set thread guide.

The overseer said that this was of frequent occurrence; that loose and improperly adjusted guides were a continual source of annoyance and loss, that it was almost impossible to keep the thread guide in place after it had once been moved. I have been told that some mills employ a man whose whole time is

spent in looking after the adjustment of the thread guides. Evidently these mills realize the loss caused by loose and badly set thread guides, and judging from what frames I have seen, it would pay more mills to detail a man for this purpose or get a thread board that will hold a guide so solid that it cannot be disarranged after adjusting.

In the article previously alluded to it states that "The breaking of ends is a matter for serious consideration". Is there a more promising place to begin this consideration than this subject of Thread Boards and Guides?

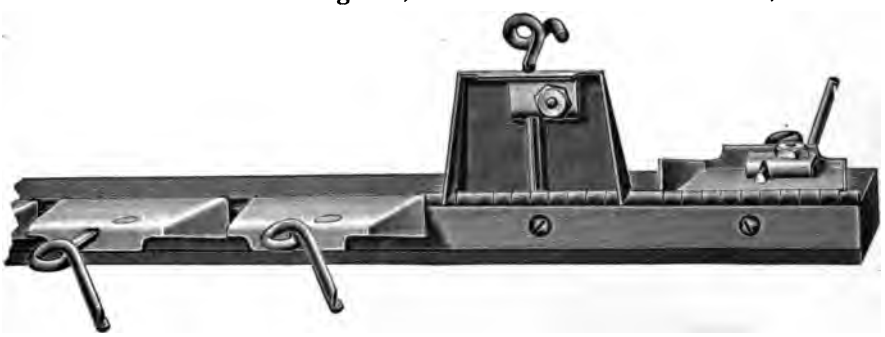
The question arises, "What are the requirements for a satisfactory thread guide (omitting the shape and the size of the guide eye about which there are so many opinions)?

There are three things that are certainly requisite, that the guides in present use never had.

First, I would have permanence. When the guide is once adjusted, it should be so solid that there never need be more thought or care given them.

Second, easy and accurate adjustment; easy, for if this adjustment requires work to do it, the chances are, it will not be done as it should be.

Third, the thread guide should be hardened, to prevent the grooving of the guide, as the grooving of the guide is a cause of broken ends. A remark that the grooving of guides was the cause of many ends breaking, that hardening had been tried and abandoned on account of the guides breaking, when bent for side adjustment, started a train of thought that resulted in a steel thread board and guide, a cut of which is here shown, and



which, in the opinion of many expert cotton spinners, fills all the requirements of a thread board and guide: of its merits or advantages you are to judge.

This thread board is made from sheet steel, in sections of eleven or twelve thread boards each, according to the gauge of frame. These thread boards interlock with a steel back strip, making a very strong construction. This back strip fastened to the thread board rail, prevents the rail from sagging or warping. (This rail may be reduced in width considerably and still be amply strong.)

The wire guide, has its BODY or STEM made IRREGULAR in FORM, which, when properly fastened, prevents it from turning or becoming displaced; by loosening a nut the guide wire can be quickly and accurately adjusted and fastened so solid that the adjustment cannot be changed.

The thread guides are specially hardened and polished and will wear a long time without being grooved, whether the thread vibrates or not. **The unqualified approval which this thread** board has received from experts in cotton spinning, especially from overseers and second hands who have given it a practical trial, warrants the statement that no one considering the purchase of ring spinning frames can afford to make their specifications without thoroughly examining this device. Here are some samples which you are invited to critically examine.

Mr. LEWIS T. HOUGHTON. I would like to say one word more. Any one desiring to try this device and wishing practical experience can send me his address and give me the gage wanted and pay the express on one and I will send it anywhere.

Mr. JOHN E. PREST. I have a section running at the Harmony Mills, Cohoes, that you sent me about ten days ago.

Mr. LEWIS T. HOUGHTON. It works all right, doesn't it?

Mr. JOHN E. PREST. I don't know yet. I want to see what the effect will be later on. It sometimes takes a long time for medicine to work.

Mr. LEWIS T. HOUGHTON. It does not take long for water to run down hill.

Mr. JOEL SMITH. I think the device is an excellent one and will accomplish good results.

(Several of the members present examined the models produced by Mr. LEWIS T. HOUGHTON and discussed the details informally with him.

The PRESIDENT. This, the most interesting discussion that we have had during the whole meeting, has been up here *sub rosa*. If there is anything further to be said we would like to hear from the members.

Mr. P. T. CREED. Mr. President, as I have had a few years' experience in the weaving and spinning department of a cotton mill, I can certainly see a little and, I think further on, quite a commercial value in that little article. I do not know that I ever saw any thread guides quite as loose as what have been presented here, but I have on many occasions seen them where they could be easily turned in and out, but the children would take the opportunity of moving them whenever the ends broke down and they thought the thread guide was the cause of the

breaking of the end, therefore turned them in or out, just as they desired. This arrangement here, I see, is permanent, and therefore cannot be turned in or out, and I actually believe that the man has struck a fair thing for a spinning frame. I think Mr. HOUGHTON has taken a step in the right direction.

Mr. JOHN E. PREST. Mr. President, one of the objectors thought that the tendency was to drive that in or out, so as to get it out of the centre. I would like to know if anybody has ever found any fault in that line. A screw you can turn, of course, or push a little in or out to suit yourself. I would like to know if any one has had any experience in that line.

The PRESIDENT. I think, perhaps, gentlemen, we will take up the next paper, Knitting Industry in the United States, by Mr. ALBERT DEABILL of Lowell, Mass.

KNITTING INDUSTRY IN THE UNITED STATES.

ALBERT DEABILL, Lowell, Mass.

Gentlemen of the New England Cotton Manufacturers' Association.

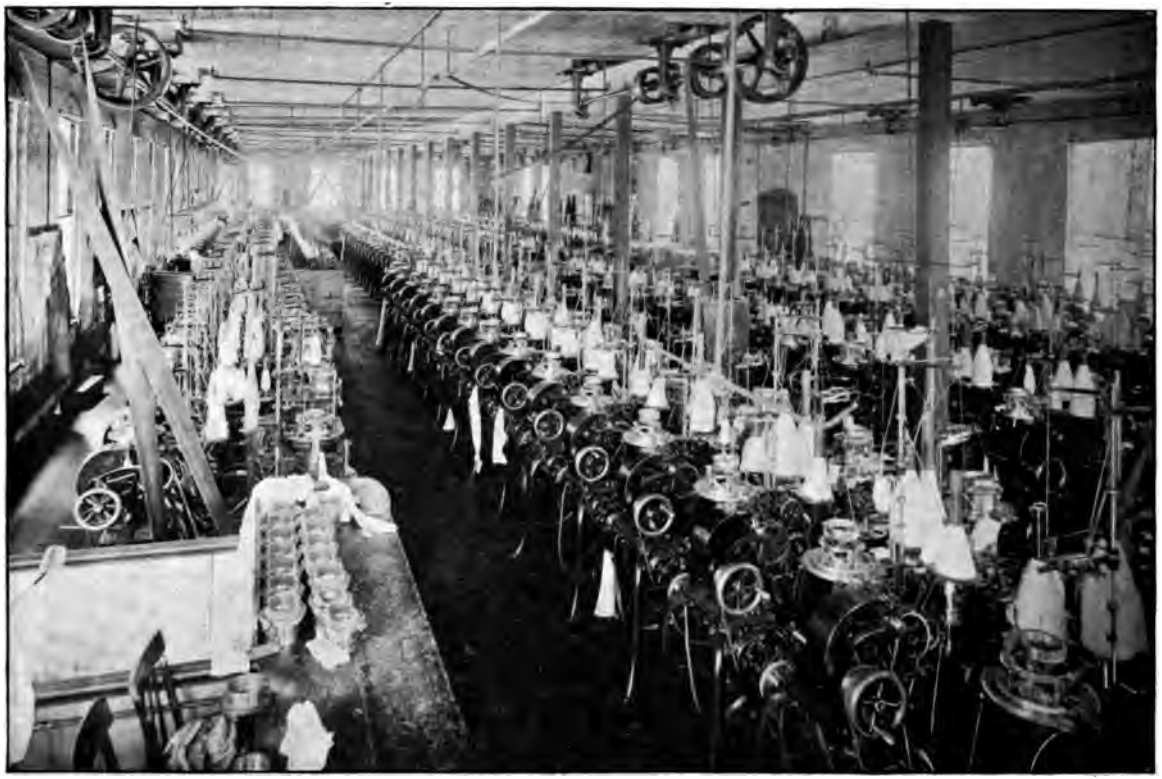
I have chosen as a subject one which has not received much attention from the Association and which may not be of special interest to the members, but the knitting industry has become such an important branch of cotton manufacturing that its requirements ought to receive the careful consideration of all the manufacturers of yarns intended for use on knitting machines, and if what I say may but serve to awaken still further interest in this subject of knitting, in all its branches, I shall feel that the introduction of the subject, in this imperfect way, has served some good purpose. I presume there is at the present time no branch of the textile industry with a wider variety of fabrics than the knitting industry, for most every kind of wearing apparel can be produced on knitting machines, and with the rapid progress in mechanical improvements, energy and capital, I have no doubt that our own knitted goods will take the lead in the race for business in the markets of the world.

The spinner and knitter are very closely connected in this business of knitting, and one of the points to which I shall call your attention is the quality of yarns which come into the knitters' hands to be manufactured into knitted fabrics.

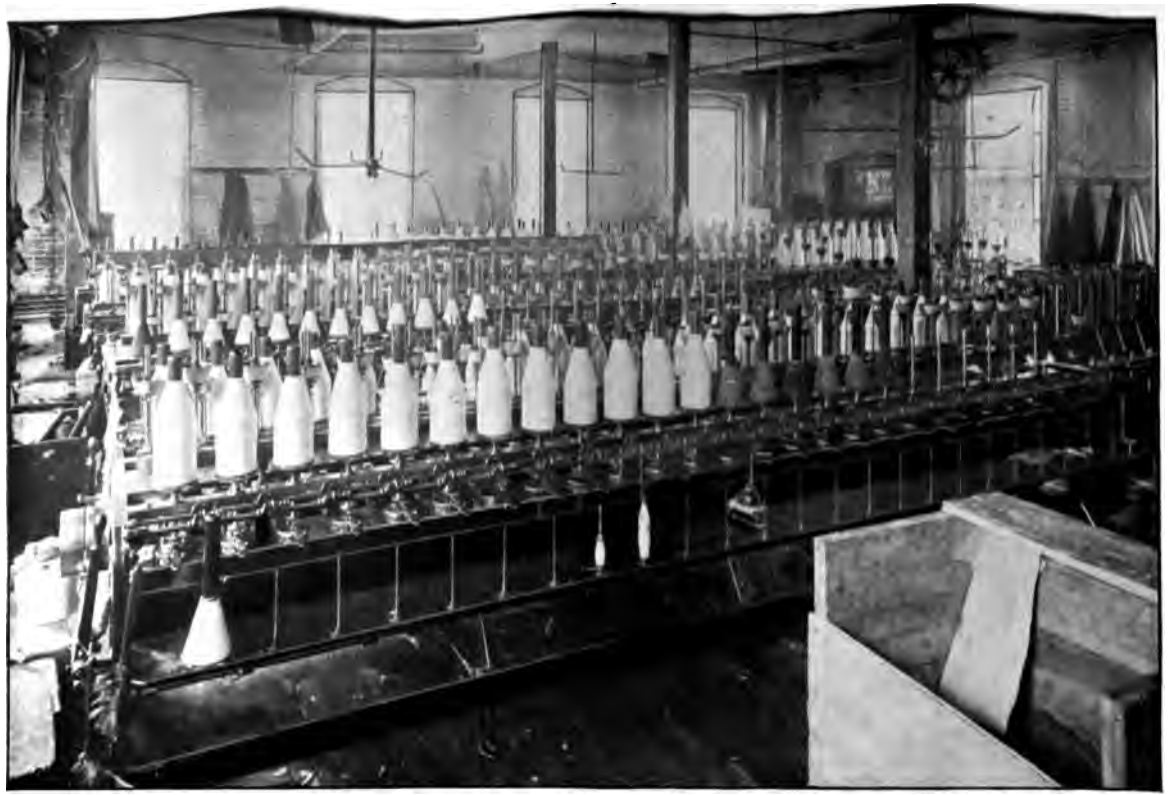
The knitting machines of today are so well constructed that if correctly set and properly cared for, there will be few delays caused by mechanism failing to work. Most of the troubles arise from causes which cannot be charged to structural weak-

ness or faults of the machine, such as poor yarns, incompetency of the operator, or inattention in allowing parts of the machine to get undue wear and out of order.

The greatest source of trouble that comes to a knitter is poor yarns, and whether caused in the card-room, spinning-room, coning, or winding, he finds the greatest difficulties that he meets are knitting yarns of poor quality into perfect goods, which is almost an impossibility. Defective yarn from any cause, whether through carding, spinning, coning, or winding, which finds its way into the knitting room, will cause a larger percentage of seconds and waste than anything else. I have seen yarn worked on knitting machines (made by an Eastern mill) that was almost worthless for anything but waste, being full of fine cuts and soft places, causing it to break back, or more plainly speaking, pulling apart in the soft, thick places by not having sufficient twist to hold it together, as all twist has gone into the finer places, and had it held together and gotten into the needles, it would have caused holes to be made and probably the breaking of a large number of needles, which would be worth more than the fabric on the machine as it would be seconds or waste; on the former of which the manufacturer has lost money, and on the latter there is a loss of fully 75 per cent. of the cost of the yarn, which is consigned to the waste house. Perhaps there is no fault in manufacturing yarns which will cause so much of it to find its way into the waste house as poor cones, as the careless operator in coning does not take pains to piece up the ends in a proper manner, but will lap on to the cone while it is in motion, thus avoiding stopping the cone and thereby increasing his pay a few cents per week. This careless work will not be discovered until the knitter gets it on to his machine; then comes the trouble, not only from loss of production but also an increase of seconds and waste accounts, and last, but not least, claims made by the knitter against the spinner for poor yarns. This being a loss and vexation to both spinner and knitter, I think it would be well if overseers both of spinning and coning, should look carefully after this matter



KNITTING ROOM.



WINDING ROOM.

and endeavor to overcome a most serious cause of complaint and expense.

An experiment made recently, under my observation, with No. 16 white carded hosiery yarn, resulted in 96½ per cent. perfect goods, 2 per cent. seconds and 1½ per cent. of waste, with an average breakage of one needle to 4-58 dozen of goods knit, and another lot of yarn, received from same mill, same quality, worked on same machines, with same operator, which through poor cones caused a breakage of one needle to 2-20 dozen knit and only 80 per cent. perfect goods, 12½ per cent. seconds and 7½ per cent. waste, found its way into the waste house, on account of loose ends on cones. This would allow the work to "run off" the machine and make pieces of knit waste from a few inches to 22 inches in length, the longest piece being too short even for seconds, besides a loss of fully 20 per cent. of production and causing the knitter to lose nearly all patience, and having to make allowances to the operator, which all go to make the profits appear on the wrong side of the ledger when the goods are finished and ready for market.

Now, having pointed out what is a fruitful source of loss and trouble in the material delivered to us to use, I will add a few words on what to me seems the best arrangement of a modern knitting-room.

First, the knitting room should be laid out in such a way that the operator is near to his machines to stop them in case of their getting out of order and failing to make perfect work, as the knitting machinery is constructed with so many delicate parts, which are easily put out of proper action through a coarse place in the yarn, bunches, or through poorly tied knots getting into the needles and breaking them — not only breaking needles but in many cases sinkers, cylinder walls, and other small parts, such as cams, screws, etc., which will put the machine out of commission from one hour to several days, according to the amount of damage done.

There should be as few driving belts as possible and they should be at the extreme end of each section of machines, and

in all cases, when possible, machines should be driven from the floor, the shaft being laid between two lines of machinery as per accompanying illustration. There are 32 machines on each shaft, taking one four-inch driving belt to supply power, thus doing away with many counter shafts and belts in the knitting-room and eliminating, so far as possible, electricity, caused by friction in driving belts, as electricity here causes no end of trouble and should be reduced to a minimum.

Machines should not be crowded together, as it is then impossible for a fixer to make any repairs on a machine without stopping several others, in order that he may get around the one on which he wishes to make necessary repairs. There should be alleys wide enough to admit of a cab being taken through them to pick up the day's work, and there should also be boxes provided and placed on the ends of each alley for the operator to put his knitted goods into, and they should be so constructed as to cover the exposed ends of the driving shafts, thus serving two purposes, one as a receptacle for knitted goods, the other as a safeguard to prevent the operator from getting hurt by the revolving shaft.

The winding-room, if on the same floor as the knitting-room, should be partitioned off, so that no flyings from here will find their way into the knitting-room, as this causes the knitting machines to become filled with lint and will not allow them to perform their proper functions. There should be properly constructed racks, marked for each number of yarn, so that when the yarn is weighed from the winder it can be put into its proper place with the least possible handling, thus making very little waste from this cause. There should be a steam box provided in close proximity to the winding-room, so that all cops or skein yarns can be steamed before winding, to take out all kink and set the twist before the yarn is wound, as this is very essential in both winding and knitting-rooms.

The rapid growth of the knitting industry in the United States in the past twenty years has been phenomenal. Twenty years ago Europe found a ready market here for all kinds of

knitted goods they could produce, but year by year it has been sending less goods to this country, until at the present day they are sending not more than 20 per cent. of what they were twenty years ago. The goods which are being imported now are a finer grade of goods than are being made in the United States, and I venture to predict that the day is not far distant when we shall not only make the cheaper goods but will also make the finer grades for our own consumption and have a surplus to sell abroad, as our mechanical skill is being demonstrated in this direction every day. Events seem to be tending in our favor towards greater gains in the world's markets, and it seems clear that the thorough organization and equipment of this branch of cotton manufacturing, with our manufacturers' skill, energy and capital, will further the purpose of extending our trade in foreign markets, and no doubt ere many years the stars and stripes will float over American supremacy in all the markets of the world.

In conclusion, will say that while we have established some of the finest textile schools in the world in this country, which are furnishing us some of the best experts in manufacturing woven fabrics, there are few, if any, where the art of knitting is taught as it is in England and Germany, for they have had thoroughly organized schools for the past fifty years, while in our country the knitting industry has had but little attention in this direction, and I trust that my imperfect presentation of the subject will serve to awaken interest and that it will be taken up later by an abler pen.

The PRESIDENT. We will take up the next paper, The Evolution of the Slubbing Frame, by Mr. FRANK P. BENNETT, JR., of Boston.

THE EVOLUTION OF THE SLUBBING FRAME.

FRANK P. BENNETT, JR., Boston, Mass.

When I told my good friend, your Secretary, that I should take for my subject at this meeting the history of some kind of roving machinery, I stated that I should probably tackle the evolution of the slubber as my special topic. I did so for two or three reasons, principal among which was the fact that I had just been making a pretty complete study of the slubber and I had decided that it was on the whole a very simple machine. It had, it is true, several motions, as, for example, the draft, the twist, the builder, the operation of the rail, and the compound gear. But, with the exception of the compound, each motion was simple enough in itself, easily understood, easily explained. The compound, of course, was neither easy to understand nor easy to explain. In fact, the overseer under whom I was working, and in whom I believe I made a good friend in spite of the fact that he always refused to accept that chief bribe of the politician, my proffered cigars, told me that the compound was a puzzler to him. in some respects, still. He was a mighty bright fellow, of considerable education and mill experience. "I have a book in my desk," said he, "on the compound which I have studied, but the fact is, I don't understand the thing yet." His room was a model of efficiency and neatness, too, so it is plain that he was not seriously discommoded by the lack of understanding he had of a part of one of his machines.

But aside from the compound, the slubber is a simple machine, hence, thought I, to trace its history is a simple matter. This pleasant delusion did not continue for long. Before I knew

why, I was face to face with the fact that the slubber was no youth in its present shape. In other words, the slubber, as made today, has been so made for more years than I have to my credit (or discredit). One successful superintendent tells me that he began his mill life 29 years ago and that the slubber is substantially the same machine now, as it was then, which meant that to trace the slubber's history, I must rely, not upon the testimony of eye witnesses, which is the only proper way, but upon the hearsay testimony of books long since packed away in those dusty corners of the public libraries which are devoted to literary "has beens" and "never beens".

I was intending to speak of the so-called "speeder" as the parent of the slubbing frame. The fact is, however, that this is correct only in part. The slubber is really an orphan in America. It has no parent here and can be said to be related to the speeder only in that it is used to do the same general sort of work, namely, taking the sliver from the drawing and reducing it to that more condensed rope of still further parallelized fibres which we call roving. The slubber merely followed the speeder. It has really no close logical connection with the speeder.

The fact is, here is another case where the English idea has supplanted the American. We Americans like to claim that we are the most inventive people in the world. We have beaten the Englishman year after year in the yacht races; our steel is beating out that from far-famed Sheffield; our bridge-builders have made their English competitors look sick when it came to competition for the African business. But when it comes to cotton machinery, we have had to bow to the Englishman time and again. His idea for cotton cards with revolving flats has knocked the American idea of a card with stationary flats higher than a kite. We have adopted the Englishman's idea. The Englishman used three series of drawing frames, a breaker, intermediate, and finisher. The American had a machine of American invention, the railway head, and two drawing frames to do the same work. The triumph of the Englishman's card caused the adoption of his idea in the drawing line; we have

dually cast aside the railway head until, so machine makers inform me, not over five per cent. of the mills are ordering new ay heads. So here is a second commercial victory for the glishman over the American.

The slubber represents a third. The American idea as shown in machines of the Taunton speeder type has been so utterly displaced by the English invention that today it is not easy to find one of these old American machines. I know I had a hard time to locate one, and when I did, it dated back Heaven knows how long.

The first and to my mind the most important motion of the slubber, is the draft. The other motions are merely subsidiary to it. The function of the slubber is to parallelize the fibres and to draw down the sliver as a preparation for spinning. All this is done by the draft. The twisting motion of the slubber is merely an auxiliary motion to prevent breaking on the slubber and subsequent machines. The building motion, the evening cones, the compound, all these are subsidiary and are simply assistant contrivances. The real motion is the draft. It has the most glorious history, too, for it dates back and owes its origin to the great ARKWRIGHT himself. The patent on what seems to have been the first successful device for drawing cotton by means of rollers revolving at different speeds was granted to RICHARD ARKWRIGHT in 1769. In his application for the patent, ARKWRIGHT describes his invention as follows: "Four pairs of rollers. That part of the roller which the cotton runs through is covered with wood, the top roller with leather, and the bottom one fluted. By one pair of rollers moving quicker than the other, draws it finer for twisting which is performed by the spindles." So, you see, in the most important feature of the slubber, the work of RICHARD ARKWRIGHT is little changed. We still have the leather top-roll and the fluted draft-roll. We shall soon see how the rest of his device was like the present slubber.

But first as to ARKWRIGHT. You all know how a successful idea is always claimed by a multitude of disgruntled inventors.

Thus the telephone, which has proved a veritable gold mine to Prof. GRAHAM BELL, is claimed by many others as their own invention. Prof. DOLBEAR, of Tufts College, for example, one of America's ablest scientists, claims, as I understand it, that his application for a telephone patent was entered at Washington before BELL'S and that only an accident there prevented him from antedating BELL'S patent. COLUMBUS sailed across an unknown sea, against the advice of learned scientists, hindered by slow vessels, constantly in danger of mutiny by his superstitious crew, and found a new land. Because he succeeded, a discoverer is brought forward by England and Norway, and even China is said to have a claimant for the discovery of America.

It is the same with ARKWRIGHT'S ideas. He entered his application for a patent in a perfectly legitimate way; proved to the satisfaction of the patent authorities that he had a new idea, interested capital, and by his genius became a wealthy manufacturer. The value of the idea of ARKWRIGHT became very evident, it stood him in a fortune, and straightway a prior invention is discovered to take away his glory and good name. The result has been to leave us much in doubt. WYATT, certainly had some similar ideas to those of ARKWRIGHT and had them a score of years earlier. HIGHS, too, conceived much the same plans and his conception, too, was earlier. But giving each of these men credit for all that they did and all that they attempted, and the reputation and genius of ARKWRIGHT stand but little blemished. Granted that he was grasping, granted that he was not at all backward in claiming all that belonged to him, granted that he was not at all loath to take another man's invention and by clever improvements cause it to make RICHARD ARKWRIGHT wealthier and wealthier, the fact remains that without ARKWRIGHT or a man of like genius the cotton manufactory of today would be impossible. Try ARKWRIGHT in the balance. Place on one side all the claims of HIGHS and WYATT urged with all the filial pride of WYATT'S son and the reverent love of HIGHS' family, and all the historical ability of a BAINES,

and upon the other side the simple fact that ARKWRIGHT made all these ideas practicable and successful, and, I believe you must admit his claim to great genius.

The spinning frame of ARKWRIGHT is the real ancestor of the present slubbing frame and the ancestor is not particularly unlike the present generation. Beside having the present draft roll idea with top roll covered with leather and held close to the bottom rolls by suspended weights, and with the only difference that both rolls were made of wood instead of metal, there was the same idea of a flyer to perform the twist, the roving entering from the top, passing down one of the legs of the flyer and being wound from thence to the bobbin. The flyer was made of wood, and instead of a tubular leg it had both legs solid with a passage way for the roving down along through a series of small parallel wire arches fastened into one flyer leg. These arches were like the eyes used in hook and eye arrangements. The spindles were operated by a continuous belt running against the base of all. Small worsted bands were put about the whorl of the bobbins, the screwing of which tight or loose caused the bobbins to wind up the thread faster or slower. In other words, as near as I can make out, there was no evening device of cones on this frame, but by tightening those worsted bands, the operative was able to keep the speed of the surface of the bobbin constant to the delivery of the roving from the draft rolls.

This frame of ARKWRIGHT'S was used alike as a roving and as a spinning frame. That was the idea in those times. The spinster in the humble cottage with her single spindle used first to make upon her spindle a cop full of roving out of the wool or cotton which she had previously carded by hand. The same wheel was then used for the spinning of this roving. With ARKWRIGHT'S invention, the roving and spinning processes were made practicable for power. At first, it is true, the new frame of ARKWRIGHT was not used for both purposes. Instead he used a simpler arrangement for making his roving. The contrivance consisted merely of having the cotton roving as soon as it had passed through the rolls fall into a can similar to

our roving cans of today. This was constantly revolving and thus gave the roving its twist. The contrivance was not wholly satisfactory, probably because of the insufficient twist and because, too, practice proved that the twist was not uniform throughout the length of the roving.

The next contrivance tried was called the jack in the box and differed from ARKWRIGHT'S idea only in the addition of a contrivance within the revolving can. The twist was still given by the revolution of the can but within was a small horizontal drum which revolved. Upon the drum, rested, horizontally, the bobbin which was, by the drum, revolved always at the proper speed in relation to the delivery from the draft rolls. The roving entered the top of the can through a small hole and was built upon the bobbin or spool by a wire which was constantly moving to and fro, and through which that roving passed. The idea was very ingenious but too complicated to be successful.

ARKWRIGHT'S ideas were brought to America by SAMUEL SLATER and other Englishmen and aided by the inventions of the Waltham or Lowell, and the Rhode Island groups of mechanics were made very workable. Now, before we study the American inventions, a word about an interesting machine which was invented about 1786 by an ingenious mechanic of Stockport, England. This was called the "slubbing billy" and was a combination of the spinning jenny and the mule. I have not been able to study this contrivance carefully, but, so far as I know, about the only new idea in the roving process which it introduced was the drawing out of the roving by a moving carriage and this idea is, as you know, not used today.

The contribution of Americans to the roving process was the speeder, there being the Taunton speeder, the Eclipse speeder, the Brown speeder and the Waltham speeder. A brief description of one, the Taunton speeder, will suffice. I know of only two or three in existence today, and the owner of one of these remarked, "That would not be worth 50 cents if you wish to buy one, but I doubt if you could find one anywhere which you could buy." The idea is very simple. After leaving the draft

rolls, the cotton passes between two tapes or belts moving in opposite directions but only the fraction of a half-inch apart. From here the roving winds upon a horizontal spool and the roving process is completed. The circumference of the spool is kept at a speed uniform to the delivery from the draft rolls, not by any complicated device like that of the cones on the slubber but because they are made to revolve solely by contact with a horizontal drum, the circumference of which is always revolved at the same speed as the delivery of the cotton from the rolls.

The speeder has a building device for giving that tapering effect of the roving upon the bobbin. The bobbins, or, more properly, spools, are upon a carriage which travels only from side to side of the frame. It is fixed upon an axis at the back of the frame but the other end of which receives a vibratory motion from left to right, from right to left, and imparts this motion to the carriage. The building effect is brought about by decreasing the length of the trip of the carriage simply by a pin upon the rack which fits in a groove in the bottom of the carriage at right angles to its course. Now it is evident that if the rack always moves through the same angle with the pin at the same point upon the rack, the carriage will always make the same length of trip. But if the pin is drawn nearer the axis, thus working in the groove upon the carriage at a point nearer the axis, the trip of the carriage will thereby be shortened. That is what is done by dogs on the side of the rack.

The great advantage about the speeder was that it was inexpensive to build and had large production. One Taunton speeder I know of, which has 22 spindles, produces 450 to 500 pounds per day of No. 1, 2 and 3 yarn, or 20 to 23 pounds per spindle. A slubber of 52 spindles working in the same mill and on stock for the same purpose, turns out 650 pounds or 12 to 13 pounds per spindle. Again, the time wasted at doffing and the difficulty of doffing is greater upon the slubber. The speeder tender merely lifted her 22 spools of roving off the frame, put 22 fresh ones in place, laid an end of roving upon

each spool and dabbed it well with water to stick it to the spool and she could then start up. How much quicker and simpler this task than doffing a modern slubber.

But the speeder had a great out, it had no means of twisting the roving and hence could be used only on coarse work. It was this fault, of course, which caused its downfall. It will be remembered that after leaving the rollers, the roving passed to the spools between two tapes near together and running in opposite directions. This was called the condensing process. And that was all it really did. A temporary twist was given the roving, but this twist did not last, for both ends of the roving were fixed and, of course, under such conditions there can be no permanent torsion.

The PRESIDENT. Gentlemen, you have heard the very interesting paper by Mr. BENNETT. Is there any discussion on this paper, or any questions to be asked?

The PRESIDENT. There seems to be no other business for the meeting, and we will adjourn until this evening at 8.30 in this room. The photographer with his apparatus is here, and we will get together as many of the members and their friends as possible, on this back piazza.

FIFTH SESSION.

THURSDAY EVENING, SEPTEMBER 26, 1901.

The Association met in the parlor of the International Hotel at 8.30 P. M., President FISH in the chair.

The PRESIDENT. The first paper in order is Steel Forgings for Factory Engines, by Mr. H. F. J. PORTER of New York City.

Mr. H. F. J. PORTER. Gentlemen of the New England Cotton Manufacturers' Association and ladies, I esteem it a privilege to be able to address you this evening, and I hope that I shall be able to place in the Transactions of your Association such information as may be of value to you as representative exponents of your industry. The paper which I have written and which is before you in printed form is complete and intact and contains everything I have to say. I have, however, a few illustrations which I will throw upon the screen, which will illustrate some of the points which I make in that paper more fully than they are brought out in the paper itself.

STEEL FORGINGS FOR FACTORY ENGINES.

H. F. J. PORTER, 100 Broadway, New York, N. Y.

During a recent visit to a New England manufacturing city the writer enjoyed the privilege of a "personally conducted tour" through some of the large mills devoted to the textile industry, in company with one of the representative mill engineers of that section of the country.

On leaving one of the older mills, after commenting on the many and great changes that had taken place in the power-plant since its installation, the engineer, knowing the writer's interest in matters historical, directed attention to an old log of unusual size lying near by. Here, fast falling into ignominious decay on the bank of the very stream which perchance at one time gave it nourishment, lay part of what was once a monarch of the forest, called for a time into man's service and used as the first shaft to convey power through an over-shot breast wheel to the machinery of the mill. About thirty inches in diameter and nearly twenty-five feet long, without a blemish in its grain it had from 1826 for more than forty-two years revolved on cast-iron gudgeons forced into its ends, driving the flying shuttle through warp and woof until a newer and more efficient servitor of man should appear to take its place and relegate the veteran to the past of pleasant memory only. Thus was the old, old story mutely told again.

The modern representative of this faithful but almost forgotten friend is by no means such a simple product, to be taken ready made from nature's garden primeval. On the contrary, it is slowly brought into existence by the patient efforts of thousands

of toilers in the mines, at the furnaces, in the great machine shops and along the lines of transportation, and stands as the proud achievement of the many minds that for years have diligently applied themselves to the sciences of chemistry, physics and metallurgy.

It will be interesting to consider the processes necessary in the manufacture of a shaft such as is required for the engine of a modern textile mill, but to do so intelligently it will first be necessary to review the circumstances that have brought it to its present high state of development.

Incidentally, also, interest will be aroused by a consideration of the utter dependence of the textile industry, during each step of its remarkable growth, upon the facilities offered by the iron and steel worker. Nor has this dependence lessened with the passage of years, for even now an exigency has arisen which the forgeman has been called upon to overcome.

Early New England factories were comparatively small affairs and up to the end of the first third of the last century utilized water, the only available power to drive breast wheels of either the "over" or "under-shot" type. Some of these wheels were of very large size, reaching up to forty feet in diameter with a twenty foot face. They were constructed upon wooden shafts around which wrought-iron bands were shrunk to support the arms that carried the buckets. In order that these bands should not slip, the shafts were made with hexagonal or octagonal sections and sometimes with even more sides. The anchor forges located along the coast were capable of turning out fairly good wrought-iron forgings of small size, and the wooden shafts of this period were thus supplied with the wrought-iron gudgeons on which they revolved. This, then, was the up-to-date power plant of the textile mill early in the last century.

The first change to take place in methods of power development came with the introduction of the turbine wheel. This wheel whether of the Fourneyron or Poncelet type, required a vertical shaft and a pipe and casing to direct the flow of water. The development of the cast-iron industry to a point where

these wheels, as well as the shafts, pipes and casings could be made, was contemporaneous with and made possible this new design of water-wheel.

This prime mover, being less cumbersome than its predecessor, became a favorite in subsequent installations, and during the next quarter century, many new factories were equipped with this type of power generator and older ones modified their original designs so as to adopt it.

Meanwhile, however, the increasing draught upon the water supply to furnish power to these added mills began to be felt, especially during seasons of drought, but happily at this time, as ever in history, man was ready to meet the emergency, and before the half century mark was reached the steam engine had advanced far enough toward perfection to be put forward as a means of overcoming the difficulty, acting as an auxiliary to the water power in times of short supply.

The first engines were of the double walking beam type and as they were slow running and operated under low steam pressures they were of considerable size, though of small power capacity. The shafts and reciprocating parts, when not so large as to overtax the capacity of the local forges, were made of wrought-iron. At this time metallurgical appliances were crude affairs, the commercial development of the country not having gone far enough to create a demand for forgings or castings of any great size.

As yet the forges possessed no better forging apparatus than tilt-hammers driven by water power. These, though light in weight, were nevertheless heavy enough to produce the small wrought-iron forgings thus far demanded by the trades. The passage of Land Grant Act in 1862, and the subsequent establishment of technical schools in the Eastern and Middle States, served as an inspiration to independent thought and intelligent effort, and the result was immediately seen in scientific attainment and industrial development, as the people began to comprehend the extent and value of the natural resources of their country.

The inventive genius of the versatile Scotch engineer, JAMES NASMYTH, had already brought forth in his country the steam hammer as a natural outgrowth of the advent of the steam engine and the more general application of steam to machinery, and small tools of this character began to supplant the cruder appliances over here.

When the Bessemer process of making steel was introduced in this country in the decade from 1860 to 1870 an era of railroad building was begun that gave a strong impetus to commercial development, the effect of which is still apparent, and as transportation facilities improved, factories started up at a distance from the coast and the ensuing industrial competition forced older establishments to enlarge their facilities for production.

The sudden appearance of steel, a new material in the market, having a reputation for greater strength and wearing properties, caused engineers and manufacturers generally to call for it as a substitute for iron for special purposes, and thus there arose a demand upon the forges for steel forgings. But where it was a somewhat simple matter to build up a comparatively large forging by welding together small faggots of wrought-iron, it was a problem of very great complexity to make a forging of the same size from a block of cast-steel, for, in the first place, steel such as is needed for forgings, does not possess the property of welding to the same extent as wrought-iron. In order, therefore, to put into the cast-steel ingot the amount of work necessary to convert it into a forging, a piece must be selected at least fifty per cent. larger than the ultimate size of the forging, and just here an obstacle was encountered by the forges in the discovery that their hammers and other appliances were all much too small to handle the larger masses of the new metal. Nor had the early workers in the elementary and readily fabricated metal, iron, the knowledge of metallurgy necessary for the proper manipulation of the finer alloy, steel, and indeed, with all the knowledge of this metal that we have since gained through the sciences of chemistry, metallurgy, physics and microscopy,

all then in their infancy, we are only now beginning to learn how little is positively known about it.

It is not to be wondered at, therefore, that the first attempts of these iron workers to manipulate a metal, of which they were totally ignorant, by means of tools and appliances wholly inadequate to the purpose, were doomed to failure. One disaster followed another in the wake of the early attempts to produce steel forgings, and it is not strange that the new and comparatively unknown material gained a reputation for unreliability, which has clung to it in the minds of some until the present day. Figure 1.

These adverse experiences brought about a tendency to revert to iron, but the strides of commercial development were so great that the large forgings required could not be turned out properly, under the small hammers then in existence, even when made of wrought-iron. Many of the large iron forgings soon broke in service, presenting either cavities in their center or at least a crystalline fracture.

This latter peculiarity for a time led the uninformed to imagine that iron and steel crystallized in service from vibration or shock. We now know, however, that any such theory is fallacious, and that these metals crystallize only in cooling from the fluid to the solid state.

The cavities in the centre were caused by the manipulation of the metal under the too rapid impacts of a light hammer, for it must be borne in mind that the molecules of heated metal require an appreciable and definite period of time in which to flow and re-arrange themselves in the shaping of the viscous mass. The force applied by the blow of the hammer is the product of the weight and its velocity, and it stands to reason that in order to work the metal properly the force should be applied slowly and continuously during the period necessary for this flow of metal. Instead, however, of obtaining an expensive equipment of heavy hammers which would, on account of the slow fall of the great weight through a short distance, produce a squeezing action, light hammers were procured at less cost

FIGURE 1. Shaft, 15 inches Diameter, Forged under 10-ton Hammer with Top Steam. Break due to Unworked Metal in Center.

FIGURE 2.—Shaft, 12 inches in Diameter, Forged under 10-ton Hammer with Top Steam. Break Due to Cavities in Center Metal.

which by means of high pressures of top steam in their cylinders drove a light weight with great velocity against the soft metal. The rapidity of these impacts affected the surface metal only and tore it from that which lay beneath. Figure 2.

Accidents occurring through the breaking of some of these imperfect forgings were sometimes serious. On account of the failure of a crank or cross-head pin, a piston or connecting rod, a cylinder-head would be knocked out carrying destruction in its path, while broken shafts have wrecked whole buildings, the accompanying damage amounting to many tens of thousands of dollars.

During this time of anxious and costly experimentation the representative engineers of the country, who kept themselves informed of the state of the art in Europe, learned that the forges there had supplied themselves with hydraulic-presses and were experiencing no trouble in turning out satisfactory steel forgings. Hence such large forgings as they needed for their engine-shafts and other heavy machine parts were imported.

The great expense attending the equipment of a forge with the large furnaces, hammers, presses, cranes and other appurtenances necessary for the proper handling of large masses of metal, long deterred the advance of the capital required for the purpose, and it was not until the United States government determined to rebuild the navy and guaranteed a sufficient volume of work to pay for an adequate installation that any concern was encouraged to make the outlay.

Beginning in 1884, The Bethlehem Iron Company (now the Bethlehem Steel Company), brought to completion in four years a plant superior to any in existence, because constructed on most modern lines, advantage being taken of the mistakes of its European predecessors. Since then this plant has supplied forgings to manufacturers of engines and heavy machinery that have met the most rigid requirements, and it will be many years before the commercial demands of the country can overtax the capacity of the ponderous forging appliances erected in those works.

It has been stated that the first engines installed in textile mills were of small capacity, the largest being capable of developing not more than 500 horse power while many were much smaller. The shafts of these engines were not larger than 12 inches in diameter, and the reciprocating parts were proportionate to them. These parts were sometimes made of cast and sometimes of wrought-iron, according to the preferences of the engineer who drew up the specifications, but the most progressive engineers insisted on their being made of steel at one of the large European forges.

As time went by and engine building became more general, the demand for larger and better forgings compelled the iron forges to provide themselves with more efficient appliances for manufacturing this product or to suffer the natural effects of decline. Power hammers of ten tons falling weight, which, with top-steam added, gave a total impact of 25 tons, were the largest made, and by means of these tools the requirements of the engine-builder were met until recent years.

The engines now being called for in textile mills have increased in size to 3,000 horse power with shafts 30 inches in diameter and with piston and connecting-rods, crank and crosshead pins approximately half that size.

For such great forgings wrought-iron cannot now be considered a satisfactory material, from the standpoint of either the manufacturer or the user. It is unsatisfactory to the manufacturer, in the first place, owing to the fact that steel has practically superseded iron in the trades, there being therefore an abundance of steel scrap in the market and some of it finding its way to the forges. Pieces of this material, which is not readily distinguishable from iron, become mixed in with iron scrap and are unavoidably worked into the forgings. As this steel scrap will not weld to the rest of the mass, it gives trouble in the forging process, if its presence is discovered, and otherwise leaves a weak spot in the finished product. Figure 3.

Then again, the welding together of the many small pieces of iron required to build up the finished mass is a long and diffi-

cult operation, owing to the many heats that have to be made, and even then the resulting forging cannot be guaranteed sound in every one of its many welded joints.

It is also found that, generally speaking, the hammer is the most satisfactory tool yet produced for the manipulation of iron in the process of welding. The great masses of metal required for one of these large shafts would naturally call for hammers heavy enough to affect the metal throughout its mass, and yet it has been found that these have a tendency to tear it apart rather than to compact it. On the other hand, considering large

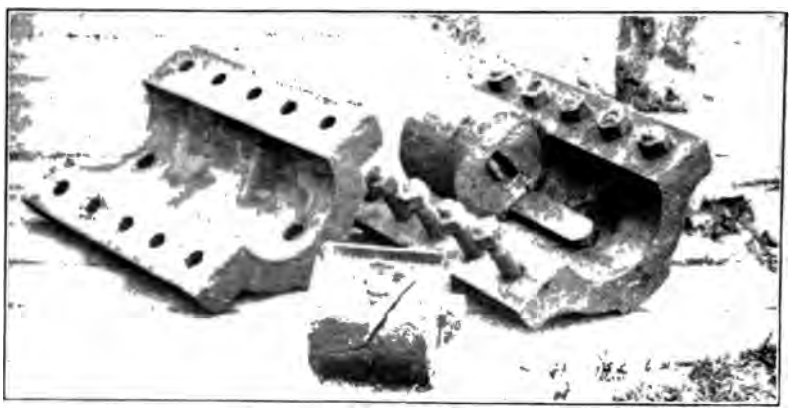


FIGURE 3. Shaft 10 inches Diameter, Forged under 6-ton Hammer with Top Steam. Break due to Steel Piece in Center.

iron forgings from the point of view of the user, this metal cannot, for the above reasons, be depended upon as far as strength and consequent safety are concerned.

The so-called fibre in iron is simply slag incorporated in the metal during the process of manufacture, and in large masses this foreign substance, representing as it does a considerable percentage of the area of a section, detracts perceptibly from the estimated strength of the metal. The average elastic limit of wrought-iron shafts of large size does not exceed 20,000 pounds per square inch. Also, owing to its low modulus of elastic-

ity, an iron shaft deflects under the heavy weights superimposed by the fly wheel, belt pulley, electric generator, etc., and this deflection leads to failure from what has been termed "fatigue of metal". Comparative tests made at the government testing bureau at Watertown, Mass., on iron shafts loaded in the center and rotated show that they will break at 50,000 revolutions, while steel shafts of the same size and weighted in the same manner will stand more than 4,000,000 revolutions.

To manufacture a large iron shaft from carefully selected metal under conditions that will tend to make it as nearly perfect as possible is such an expensive operation that its cost becomes excessive, and a better shaft made of steel can now be readily obtained for less money. To produce this shaft has been the self-imposed duty of the steel manufacturer.

The merits of a steel shaft as compared with one made of iron can best be exemplified by showing its freedom from the defects that are known to be inherent in the latter.

In the first place, when the raw materials of which steel is composed are melted into a fluid mass, all the slag and dirt that may have entered the furnace during the charging process float to the top and are drawn off. Thus the resultant casting from which the forging is subsequently made is a perfectly clean piece of metal. Furthermore, this being a single piece initially there are no welds in it to cause weak spots. Then, again, steel has an elastic limit from twice to three times that of iron, and is therefore stronger, and, having also a higher modulus of elasticity, does not deflect under bending stresses to the same extent as iron, and so does not yield as readily to fatigue of metal.

A noticeable feature of the shafts and minor forgings of the large engines recently installed in textile mills by representative engineers is that they are hollow. They have other features also which are as characteristic and yet are not so apparent. These characteristics are so peculiar to modern methods of manufacture and are so little understood and appreciated that a few words in explanation will perhaps be pertinent. In order to be fully understood it will be best to select a large hollow

shaft as a representative forging, and describe the various processes of manufacture necessary to produe it. Figure 4.

Beginning with the primary operation, the casting of the ingot will first receive consideration. In making up the charge to be melted for the production of the casting from which the subsequent forging is to be made, the composition of the various raw materials must be considered. These raw materials, such as iron-ore, scrap-iron, etc., have various elements in their composition, especially carbon, silicon, manganese, phosphorous and sulphur, each of which effects the strength of the resultant product.

So also must the amount of material be carefully estimated. Remembering that the casting must be reduced in size in the forging process, 50 per cent. at least must be added to the area of section of the initial casting over and above that of the finished forging. In addition, 25 per cent. must be added to the length for reasons which will be made apparent.

Having properly charged the furnace with the requisite quantity of materials of the right composition, and heated the charge until it has melted, a small dipperful of the fluid is withdrawn and tested to observe if the mixture is proving itself to be according to calculation. Such additional ingredients as are required are put in as occasion may demand and when the charge is satisfactory it is run into a ladle and from it is poured into the mould. In the pouring process air is apt to be entertained which may cause "blow holes", and in the process of cooling, gases are sometimes generated which may cause the same kind of defect, or possibly only spongy spots. Such occurrences must be obviated at the outset by taking proper precautions, for as steel does not weld satisfactorily these defects cannot be eliminated as its manufacture progresses and are in fact greatly aggravated.

Many methods have been devised to secure freedom from these imperfections, but the most satisfactory of them all is the so-called "Whitworth process of fluid-compression" in which the metal in the mould is subjected, while in the molten state, to a pressure running up to 7,000 tons and this pressure is con-

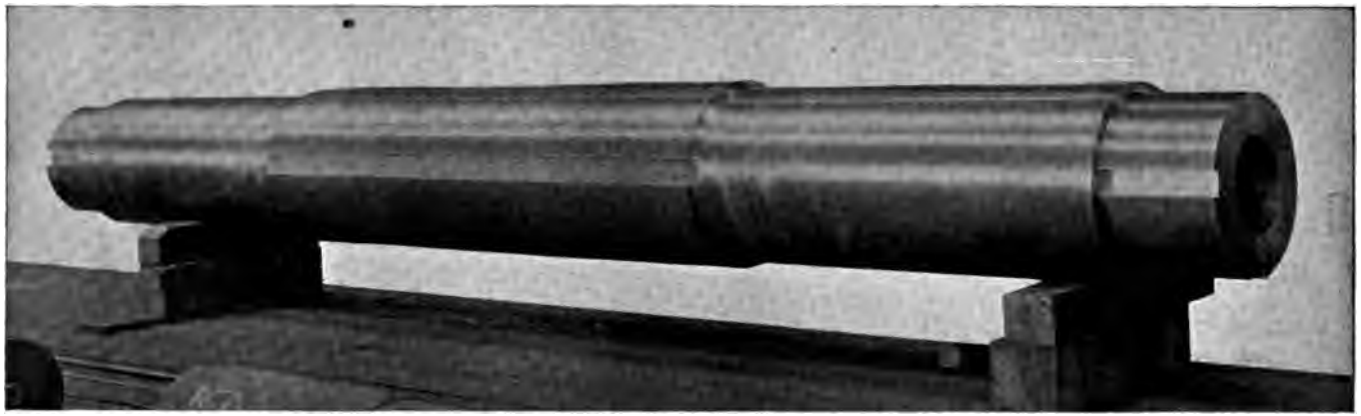


FIGURE 4.— Hollow Forged Shaft for Mill Engine, 26 inches Diameter with 9-inch Axial Hole.

tinued until the mass is cold. This process also tends to avoid another serious defect known as "segregation" As each of the various elements above mentioned solidifies at a different temperature there is a tendency in them to separate from one another and to seek in the molten liquid their proper location according to their respective specific gravities. The effect of this action, which is partly chemical and partly mechanical, is to draw them towards the center and top of the mold where cooling takes place last. This tendency is checked, however, under the great pressure to which the fluid mass is subjected by the process just mentioned. Figure 5.

"Piping" is a term applied to another defect that is apt to occur in large ingots. When the mould is filled with molten metal, that part which is located at the surface of the mould cooling first solidifies there and as the cooling process continues, forms a gradually contracting vessel filled with liquid steel.

When the whole mass has cooled, it is found that there is a "pipe" or hole running down through the center of the ingot, which is due to the combined contraction of the mass during the cooling process. The fluid compression by forcing the hot metal down from the top of the ingot, which cools last, tends to fill this pipe, and thus produces a solid mass of steel. When the ingot has solidified it is removed from the mould and allowed to cool, care being taken that the rate of cooling is not so rapid as to contract the surface of the metal on to that in the center and thus cause exterior cracks. The upper part of the ingot which has supplied metal under pressure to fill the "pipe", and has in addition served to collect the surplus segregated elements, is not considered suitable for forging purposes and is therefore cut off and discarded. This will explain the addition of the 25 per cent. added to the length of the ingot as originally designed.

The tendency in steel ingots to have an imperfect core or center led initially to the removal of the defective material from that portion of the forging by boring, and thus hollow shafts were first brought into service. The boring of a shaft necessa-

FIGURE 5.— Fluid Compression Plant.

rily weakens it, however, by so much strength as is possessed by the metal removed.

It was only when hydraulic presses were introduced as forging tools that so-called "hollow forging" became practicable. In this process after the ingot has been bored it is heated slowly and carefully so as not to subject the metal to the danger of cracking from too rapid expansion. A mandrel is then inserted through the axial hole and the ingot with the mandrel in its centre brought under the hydraulic press and worked by slow and repeated pressure until it assumes the desired shape and size. Thus the mandrel acts as an internal anvil and enables the press men to thoroughly work the thin walls of the hollow shaft and to allow the flow of the molecules of the metal, throughout the whole mass, to take place slowly and completely. Figure 6.

In the case of large forgings as the metal is slowly cooling during the forging process, several re-heatings may be necessary before the desired shape has been obtained. This working at various temperatures tends to set up strains in the metal which, if not relieved, would be apt to develop later in service and spring the forging out of shape, possibly causing fracture.

To relieve these strains "annealing" is resorted to. This consists in heating the whole forging to an even and definite temperature, dictated by experience, and then allowing the furnace with the forging in it to cool down slowly. By this means the forging cools evenly and is not exposed to currents of air, which striking it on one side or in one part of its length, would set up local strains.

Annealing, besides relieving strains, gives the metal a fine grain and thus increases it strength, for the finer the internal structure the greater is the inter-molecular attraction and the stronger and tougher the metal.

There is another treatment by which the grain of the metal can be made still smaller than by annealing, and with consequent increase of strength. This treatment is called "oil-tempering" and consists in heating the forging to a higher temperature than

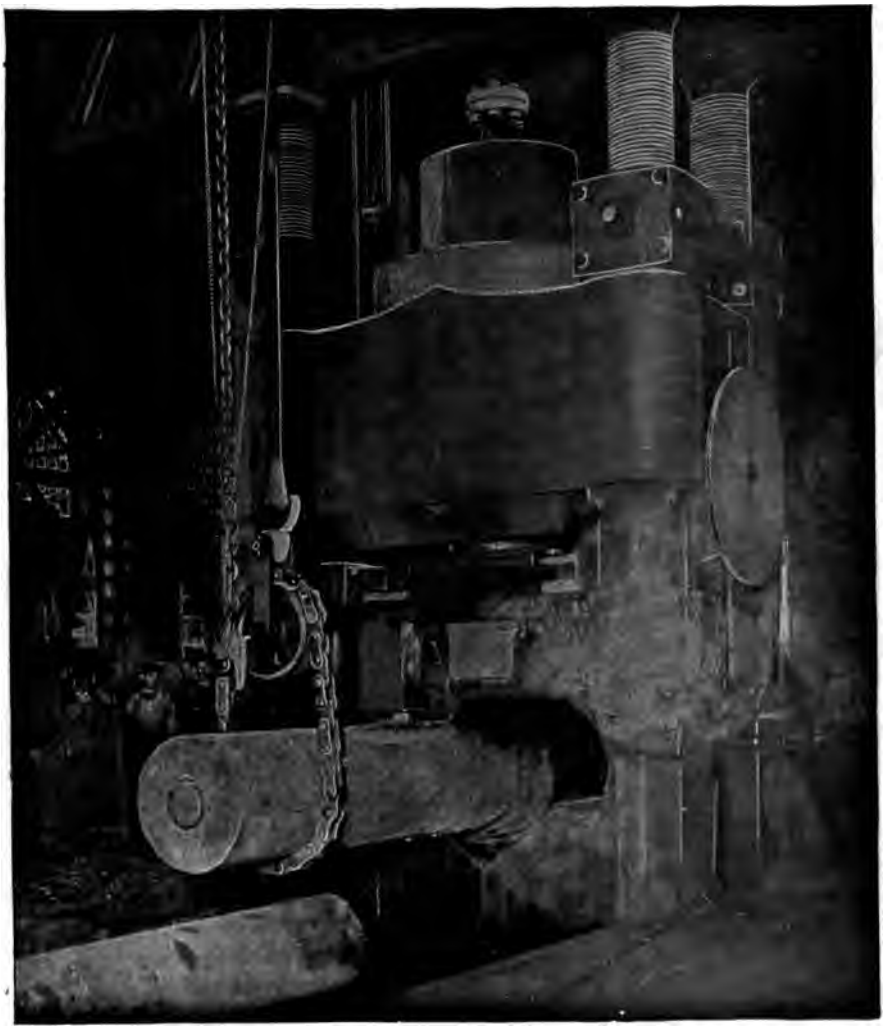


FIGURE 6.— Hollow Forging
A 22-inch Shaft under a 5,000-ton Hydraulic Press.

that called for by the annealing process, and then plunging it into cold oil, water, or any other fluid that will rapidly conduct away the heat. This sudden cooling gives so little time for the grain to form that the resultant structure is very minute.

The combined effect of annealing and oil-tempering is to produce the strongest steel that can be made, and this is especially true of steels containing a small percentage of some of the rare elements, nickel for example.

In the design of steel shafts, and more especially some of the smaller and more intricate forms of engine forgings, such as connecting rods, piston rods, etc., care should be taken that no sharp angles or "set-downs" occur, for they are apt to be starting points for cracks, which may develop in service and cause failure. It is easy to supply ample fillets at such places and thus avoid this danger. Figure 7.

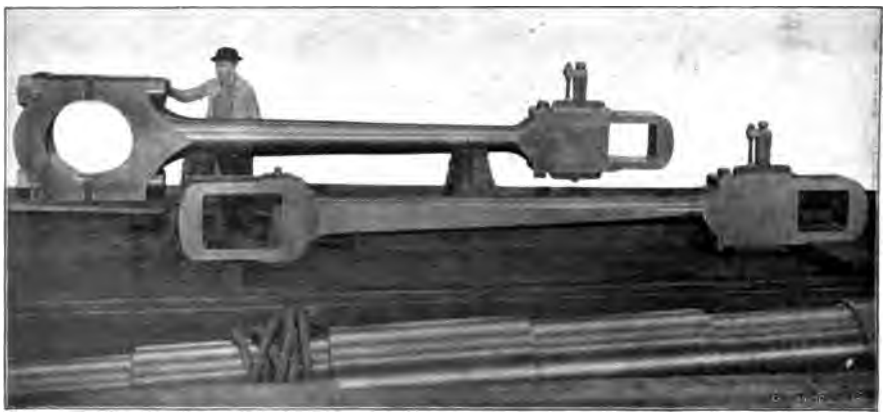


FIGURE 7. Connecting Rods for Mill Engine.

When steel forgings are properly designed, and made by what are now recognized as correct methods from a composition of metal selected as appropriate for the service to which the forging will be subjected, all danger of accidents from their failure is eliminated, and the slight excess of cost over steel

forgings improperly manufactured may be looked upon in the nature of insurance.

Engine-builders, however, although fully alive to the advantages offered by high grade forgings, are deterred from their use by not only this initial cost, but the added expense of machining them, owing to their toughness. This cost may lose them an order in a close competition, and especially when dealing with a purchaser who is not informed of the difference in the quality of the material offered. It is, therefore, to the interest of the engineer, who is engaged to draw up the requirements of the engine contract, to specify exactly the grade of steel that he desires to have used in his engine-forgings, and to insist upon these specifications being so interpreted that all the engine builders base their estimates on the same grade of material.

He must also see that the forgings when ordered meet the requirements of his specifications, by careful inspection and test during the process of their manufacture.

The following instances of this practice will illustrate the principle referred to:

In 1896 when Capt. CHARLES H. MANNING, superintendent of the Amoskeag Manufacturing Co. at Manchester, N. H., determined to put in an auxiliary engine to supply power during seasons of dearth of water supply, he contracted for a 2,000 horse power vertical engine. As this engine was to run at more than 230 revolutions per minute at high steam pressures, he desired to be amply secured against accident from the breaking of the reciprocating parts. These he covered by specifications as follows: The piston-rods and crossheads are to be forged from one piece of open hearth carbon steel, annealed of the following physical properties. Elastic limit 40,000 pounds, elongation 22 per cent. The connecting rods, crosshead and crank-pins and crank shaft to be of open hearth nickel steel, all hollow as shown and of the following physical properties. Elastic limit 50,000 pounds, elongation 25 per cent. The qualities are to be obtained in the standard United States navy

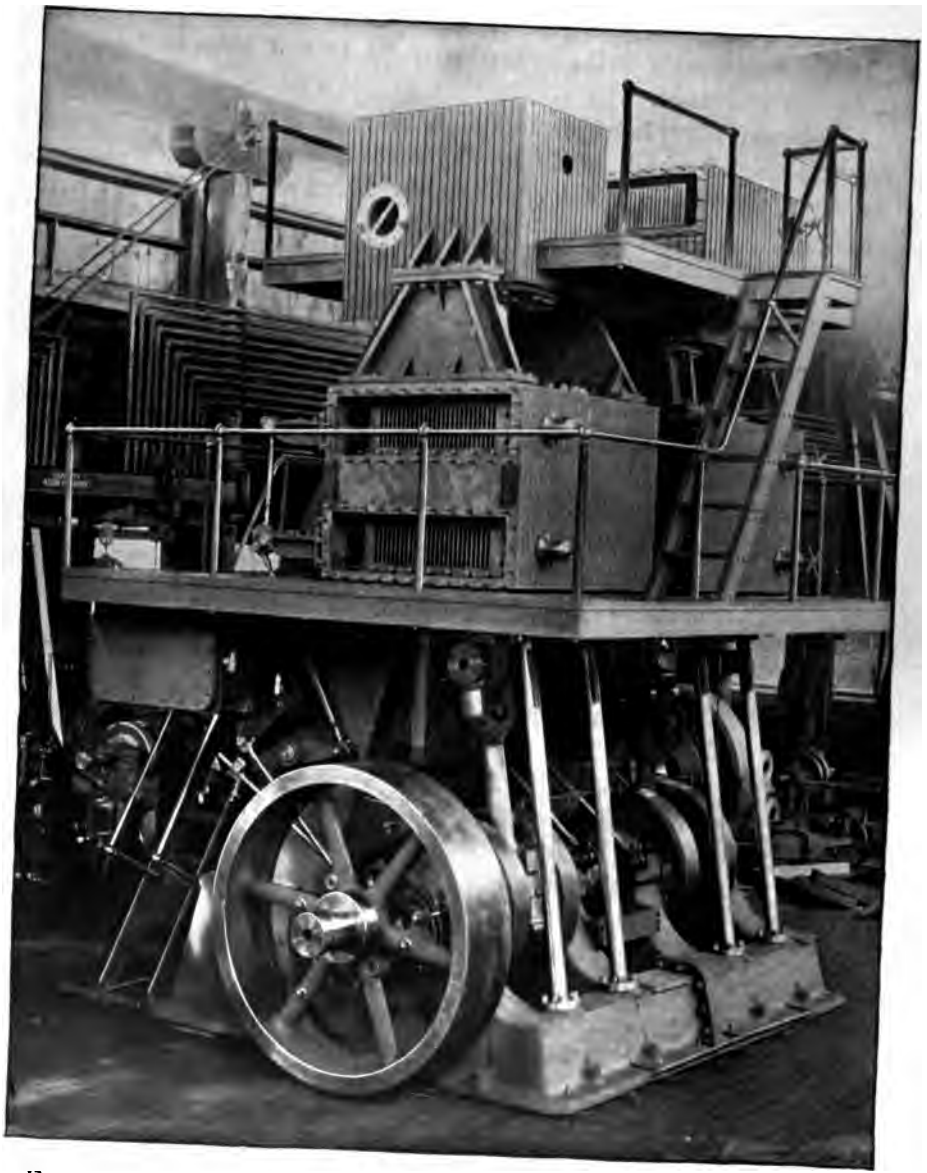


FIGURE 8. 2. [illegible] H.P. Engine for Amoskeag Mfg. Co., with Hollow Shafts and Connecting Rods.

test bar ½ inches diameter x 2½ inches long between gauge marks. Figure 8.

The shaft for an engine now being built for this same mill is 30 inches diameter and 25 feet 10⅜ inches long with a 10-inch hole running through its centre. It is to be of fluid compressed open hearth steel and to meet requirements of 40,000 pounds. Elastic limit and 22 per cent. elongation in a standard United States navy test bar.

More recently, where a large wrought-iron shaft broke in the engine of one of the older mills in Fall River (Figure 9), the mill

FIGURE 9.

engineer, Mr. W. T. HENRY of that city, specified that it should be replaced by a shaft made of fluid-compressed steel having physical properties approximately those called for above. Had time permitted, this shaft would have been ordered hollow forged. In a new engine recently ordered for this mill the shaft is to be of fluid compressed steel forged hollow on a mandrel and oil tempered.

The International Association for Testing Materials is now establishing specifications covering a series of standard grades

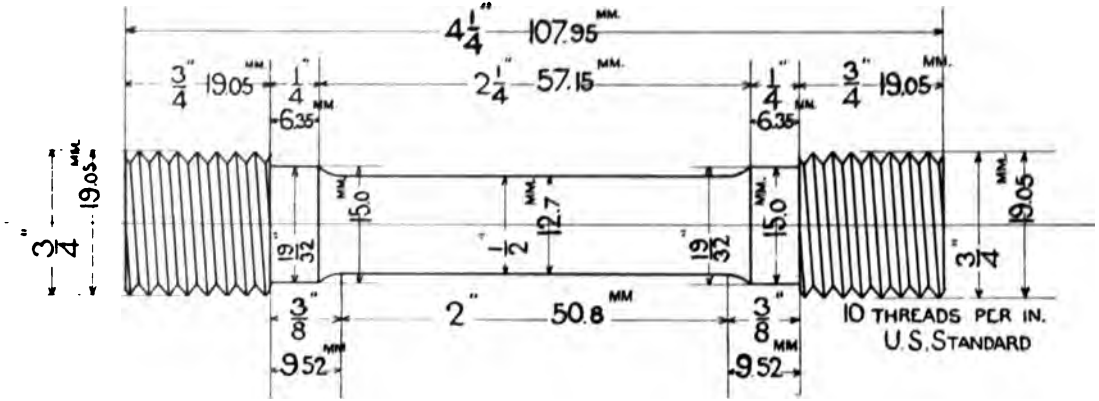


FIGURE 10. United States Navy Standard Test Bar.

of steel, which they recommend to all engineers both in this country and abroad, and advise that the kind wanted be specified by its physical properties and that, also, these specifications be enforced by the actual inspection of a test bar taken from a full sized prolongation of one end of the forging. The size of test bar recommended in that adopted by the United States navy as standard and is one-half inches diameter and two inches long between measuring points.* Figure 10.

The writer hopes that by calling attention to the direction in which modern practice is advancing he may be able to place in the hands of some who might not otherwise obtain it, information that may tend to aid them in future emergences, if indeed he does not accomplish more than this and diminish the number of accidents that occur annually. If it has been made plain that the forgeman of the present day is working more intelligently than before in consequence of the flood of light that the sciences have poured upon his industry, and that he is taking a foremost part, as ever, in fostering the progress of the other industries in the great advance of commercial developement which the 20th Century has inaugurated, the writer will be more than satisfied.

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*See Appendix.

APPENDIX.

STANDARD SPECIFICATIONS FOR STEEL FORGINGS.

ADOPTED AUGUST, 1901, BY THE AMERICAN SECTION OF THE INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

Process of Manufacture.

1. Steel for forgings may be made by the open-hearth, crucible or Bessemer process.

Chemical Properties.

2. There will be four classes of steel forgings which shall conform to the following limits in chemical composition.

	Forgings of soft or low carbon steel.	Forgings of carbon steel not annealed.	Forgings of carbon steel oil tempered or annealed.	Forgings of nickel steel oil tempered or annealed.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Phosphorous shall not exceed	0.10	0.06	0.04	0.04
Sulphur " " "	0.10	0.06	0.04	0.05
Nickel " " "	——	——	——	3.00—4.00

Physical Properties.

3. The minimum physical qualities required of the different sized forgings of each class shall be as follows:

Tensile Tests.

Tensile Strength.	Elastic Limit.	Elongation in 2 inches.	Contraction of area.	
Pounds per square inch.		Per Cent.		
				SOFT STEEL OR LOW CARBON STEEL.
58,000	29,000	28	35	For solid or hollow forgings, no diameter or thickness of section to exceed 10″.
				CARBON STEEL NOT ANNEALED.
75,000	37,300	18	30	For solid or hollow forgings, no diameter or thickness of section to exceed 10″.
				CARBON STEEL ANNEALED.
80,000	40,000	22	35	For solid or hollow forgings, no diameter or thickness of section to exceed 10″.
75,000	37,500	23	35	For solid forgings, no diameter to exceed 20″ or thickness of section 15″.
70,000	35,000	24	30	For solid forgings, over 20″ diameter.

Tensile Strength.	Elastic Limit.	Elongation in 2 inches.	Contraction of area.	
Pounds per square inch.		Per Cent.		
				CARBON STEEL, OIL TEMPERED.
90,000	55,000	20	45	For solid or hollow forgings, no diameter or thickness of section to exceed 3″.
				CARBON STEEL, OIL TEMPERED.
85,000	50,000	22	45	For solid forgings of rectangular sections not exceeding 6″ in thickness or hollow forgings, the walls of which do not exceed 6″ in thickness.
80,000	45,000	23	40	For solid forgings of rectangular sections, not exceeding 10″ in thickness or hollow forgings, the walls of which do not exceed 10″ in thickness.
				NICKEL STEEL, ANNEALED.
80,000	50,000	25	45	For solid or hollow forgings, no diameter or thickness of section to exceed 10″.
80,000	45,000	25	45	For solid forgings, no diameter to exceed 20″ in thickness of section, 15″.
80,000	45,000	24	40	For solid forgings, over 20″ diameter.
				NICKEL STEEL, OIL TEMPERED.
95,000	65,000	21	50	For solid or hollow forgings, no diameter or thickness of section to exceed 3″.
90,000	60,000	22	50	For solid forgings of rectangular sections not exceeding 6″ in thickness or hollow forgings, the walls of which do not exceed 6″ in thickness.
85,000	55,000	24	45	For solid forgings of rectangular sections not exceeding 10″ in thickness or hollow forgings, the walls of which do not exceed 6″ in thickness.

Bending Test.

4. A specimen one inch by one-half inch (1″ x ½″) shall bend cold 180° without fracture on outside of bent portion as follows:

Around a diameter of ½″, for forgings of soft steel.

Around a diameter of 1½″, for forgings of carbon steel not annealed.

Around a diameter of 1½″, for forgings of carbon steel annealed, if 20″ in diameter or over.

Around a diameter of 1″, for forgings of carbon steel annealed, if under 20″ diameter.

Around a diameter of 1", for forgings of carbon steel, oil-tempered.

Around a diameter of ½", for forging of nickel steel annealed.

Around a diameter of 1", for forgings of nickel steel oil-tempered.

Test Pieces and Methods of Testing.

Test Specimen for Tensile Test.

5. The standard turned test specimen one-half inch (½") diameter and two inch (2") gauged length, shall be used to determine the physical properties specified in paragraph No. 3. It is shown in Fig. 9.

Number and Location of Tensile Specimens.

6. The number and location of test specimens to be taken from a melt, below, or a forging, shall depend upon its character and importance and must therefore be regulated by individual cases. The test specimens shall be cut cold from the forging or full-sized prolongation of same, parallel to the axis of the forging and half-way between the center and outside, the specimens to be longitudinal, *i. e.*, the length of the specimen to correspond with the direction in which the metal is most drawn out or worked. When forgings have large ends or collars, the test specimens shall be taken from a prolongation of the same diameter or section as that of the forging back of the large end or collar. In the case of hollow shafting, either forged or bored, the specimen shall be taken within the finished section prolonged, half way between the inner and outer surface of the wall of the forging.

Test Specimen for Bending.

7. The specimen for bending test one inch by one-half inch (1" x ½") shall be cut as specified in paragraph No. 6. The bending test may be made by pressure or by blows.

Yield Point.

8. The yield point specified in paragraph No. 3 shall be determined by the careful observation of the drop of the beam, or halt in the gauge of the testing machine.

9. The elastic limit specified in paragraph No. 3 shall be

determined by means of an extensometer, which is to be attached to the test specimen in such manner as to show the change in rate of extension under uniform rate of loading, and will be taken at that point where the proportionality changes.

Elastic Limit.

10. Turnings from the tensile specimen or drillings from the bending specimen or drillings from the small test ingot, if preferred by the inspector, shall be used to determine whether or not the steel is within the limits in chemical composition specified in paragraph No. 2.

Sample for Chemical Analysis.

Finish.

11. Forgings shall be free from cracks, flaws, seams or other injurious imperfections and shall conform to dimensions shown on drawings furnished by the purchaser, and be made and finished in a workmanlike manner.

Inspection.

12. The inspector representing the purchaser shall have all reasonable facilities afforded to him by the manufacturer to satisfy him that the finished material is furnished in accordance with these specifications. All tests and inspections shall be made at the place of manufacture, prior to shipment.

The PRESIDENT. Gentlemen, you have heard the most excellent and most interesting paper by Mr. PORTER, whose tribute to Mr. JOHN FRITZ is particularly pleasing and particularly touching to all of the engineers of the whole world, be they the old engineers or the new engineers. I am very glad to see such a paper as this appear upon the Transactions of the Association. If there are any questions to be asked, no doubt Mr. PORTER will be pleased to answer them. If not, we will pass to the next paper, which is, Early Southern Cotton Mills, by Mr. D. A. TOMPKINS of Charlotte, N. C.

Mr. D. A. TOMPKINS. Mr. President, ladies and gentlemen, Mr. PORTER'S very interesting paper, has, I am afraid, not only dwarfed what I have to say, but caught my attention to the extent of carrying me back to where I feel quite at home. I used to work for the Bethlehem Iron Works, and Mr. JOHN FRITZ, in engineering and in manufacturing was my foster father. I lived under his influence and worked under his direction for more than ten years in many parts of this country and in different parts of Europe. I more than concur in what Mr. PORTER has said of him in respect to his good judgment, his extraordinary intellect and his great capacity for accomplishing results with material things. I believe that he has done more to put forward the business of the production of steel and have it thoroughly understood where to use it and where not to use it than any other man in the world.

EARLY SOUTHERN COTTON MILLS.

D. A. TOMPKINS, Charlotte, N. C.

Coming as I do from a section far to the southward of where most of you live, yet in a section having a fair membership in this Association, it would seem appropriate before entering upon the subject of my address to express what I know is the sentiment of all the Southern members of this Association and Southern people, besides, the feelings of our grief and sympathy with you because of the late national calamity. In the private life of all the people in the South the regret and disappointment for what befell President MCKINLEY cannot be measured in words. I will read an extract from a private letter written, by my brother at Edgefield, S. C., to me in connection with some passing business matters:

"I am overwhelmed with sorrow at the death of President MCKINLEY. He was a good man, with a broad mind and a kind heart. He has especially endeared himself to the South, both for any want of bitterness and by many kind acts and loving words, and he has earned for himself in that beautiful beyond the reward 'Blessed are the peacemakers, for they shall be called the children of God.' "

From my sister, who lives in Abbeville, S. C., I had a letter also which contained similar expressions. In every phase of the private life and work of our people there have been sad hearts, deep feelings of sorrow for the man whose life was sacrificed, and solicitude for the future welfare of the government and the people.

The general sentiment seems to be strongly in favor of repressive measures and even severe punishment to put a stop to

with one hundred and forty-four flier, with three sets of fluted rollers, the back set to be of wood, the other two sets to be of iron; the machine to be made in two frames with two sets of wheels; one carding machine with two sets of saws and two ropings, each to be one foot de, with a picking machine to be attached to it with as many saws as be necessary to feed the carding machine; one roping with heads. All the above machinery to be completed in a workmanke manner. **And the said BEAN is to board himself and find all the materials for the machine and set the machinery going on a branch on ABSALOM WARLICK's land below where the old machine stood; the said SCHENCK and WARLICK are to have the house for the machine and the running gears made at their expense; but the said BEAN is to fix the whole machinery above described thereto; the wooden cans for the roping and spinning and the reel to be furnished by said SCHENCK and WARLICK; all the straps and bands necessary for the machinery to be furnished by said SCHENCK and WARLICK. In consideration of which the said SCHENCK and WARKICK are to pay the said BEAN the sum of thirteen hundred dollars as follows: to wit: three hundred dollars three months from this date, one hundred dollars six months from this date, and the balance of the thirteen hundred dollars to be paid to the said MICHAEL BEAN within twelve months after said machine is started to spinning. In testimony whereof, we have hereunto set our hands and seals the day and year above written.**

ABSALOM WARLICK [SEAL.]
MICHAEL SCHENCK [SEAL.]
MICHAEL BEAN [SEAL.]

Test: ROBT. H. BURTON."

The descendants of this same MICHAEL SCHENCK are now extensively and successfully in the mill business in North Carolina. There was an interim, when slavery was supreme, when probably all the members of this family were planters and not manufacturers, but on the abolition of slavery and the re-establishment of conditions favorable to manufacturers, those having most of the inherited taste found it easy to take up a business for which there was in their bones an inherited capability.

As it was with this factory so it was with many others. A family by the name of BATES had extensive cotton milling interests near Greenville, S. C. Col. H. P. HAMMET, and after him Col.

ORR of Piedmont, have in their families the inherited taste and capabilities of these people. I could cite numerous instances to show that the facility with which manufactures are established and developed in the South by native people is but a revival of what the ancestors of these same people did.

The assistance of New England in helping to bring the rusty talents and skill up to date has been invaluable. I wish to call attention to the fact that we have now re-established the growth of manufactures in the United States on the basis made by the founders of this nation and its early rulers, that is throughout the entire country alike where conditions are favorable. The most favorable locations for spinning and weaving seem to be a section in New England and New York state, another section in the Middle States (about Philadelphia and Baltimore) and still another in the Piedmont region of the South. In most of this territory the soil is not very fertile and, therefore, farming is not attractive. Neither are there other interests like iron or coal or commerce at hand to disturb the regularity or economy of the labor market. Regular work and economy are the prerequisites of cotton manufacture, especially of coarse or standard goods.

This kinship of occupations and conditions naturally makes for common interests. We are so similarly situated as to make coöperation for our common interests of the utmost importance to us all. The new conditions in the South are but a repetition of old conditions. The new conditions are undoubtedly permanent. Slavery is gone forever. Therefore, our factories will, this time, stay with us. In this situation the North and South are not competitors, but have the common interest to find markets for our surplus goods. If we find these markets there is more than enough profitable work for the factories of all the textile area in New England, the Middle States and the South. If in controversy we fail to coöperate to get these markets we will not have business enough for any one of the sections. When we had slavery and you were fighting for free institutions, it was natural that we should have drifted apart, and very widely

apart. It was natural that our people should have gone to Washington asking for one set of propositions and that you should have met us there with another set of propositions. But we must now recognize that that condition is totally changed; that the textile territories of New England and New York, of the Middle States and the Piedmont region, are as identical in interest as they were more than a hundred years ago; that the people have an interest that is as identical as it was when our forefathers fought together for the common purpose of establishing a nation on this side of the Atlantic. When we come to recognize that fact there will be no more trouble; we shall have no difficulty whatever in so extending our commerce by coöperating in asking for what we want in its extension, and there will be a greater demand for textile goods than the South and New England put together can supply. There is no such thing as competition where our interest lies so close together. The only competition that can possibly exist within it is that which would arise when we misunderstand each other, when we squabble over something that is of no consequence and leave alone the development of foreign markets which are of great consequence.

Our failure to recognize the identity of interest between the South and the North reminds me of an incident that occurred not long ago in North Carolina. The states of North and South Carolina have been squabbling over the division line ever since the states were separated. When South Carolina gets ready to run a survey North Carolina is not ready; so South Carolina establishes a line, and then North Carolina proceeds and runs another line to change it. It has been changed, I suppose 25 or 30 times. Not long ago a surveyor from South Carolina was running the line, and he ran it just north of the house of an old lady who had always before been in North Carolina, but was now thrown in South Carolina. She was exceedingly indignant, said she would'nt have it and he must run that line again. Argument was no use whatever. She simply insisted that the line must be put back south of her house. The

surveyor asked, "What difference does it make anyway, Mrs. JONES? You have your house just the same and you have your land." "It makes all the difference in the world," she said, with emphasis; "I am not going to live in any such unhealthy state as South Carolina." [Laughter.] And he yielded and put her back in North Carolina.

Our conception of the difference between us, this talk of competition between the North and the South, is very much the same as the old lady found in the healthful conditions when the line was run north of her, placing her in South Carolina.

Personally, I quite concur in the views expressed by our late President in favor of reciprocity in his last speech at Buffalo. I believe that by reciprocity we may continue undisturbed the policy of protection for such of our products as need it, and at the same time extend our markets for those products which we make in excess of our domestic requirements. In these matters we ought to have free discussion among ourselves to reach conclusions, and then bring our combined influence to bear at Washington for policies that will conduce to our common advantage and to the advantage of our country.

Pursuant to this idea of finding markets for the export of our surplus product, the people of Charleston, S. C. have undertaken an exposition which will be essentially an export exposition. It is designed to invite to the exposition many of the most important merchants of Cuba, Porta Rico and South America. Application has been made to the general government to bring from Cuba a number of merchants to Charleston on the same basis that the teachers were brought from Cuba to Harvard. It is intended that the mills in the United States shall invite these merchants to come to see the processes of manufacture. It is proposed to ask them to visit the mills at the expense of the manufacturers, and direct the putting up of more or less bales of goods in exactly the shape that they want them for shipment to their country. We hope that this will tend to overcome this constant complaint about the American manufacturer not being willing to put up goods to suit the foreign mer-

chant. I believe if we will spend a little money in that form of hospitality, if we will take a little trouble to bring the foreign merchant to our mills and confer with him about these details, that there will be no trouble whatever in developing a trade of five, ten or twenty-five million dollars worth of goods with South America instead of the one million dollars which we now enjoy out of their trade of fifty million dollars. It is really a curious situation. The American is so extraordinarily enterprising in working his own territory, combing it and combing it again. He will send a drummer to see a man in this country to sell him an engine or to sell him cloth over and over again; but where there is larger trade and less competition and a greater opportunity to distribute goods farther and at better prices, the field is absolutely neglected. That is another case of having a fixed impression and staying by it. It is another case of adhering to our own opinions, like the old lady in North Carolina of whom I spoke, who didn't want to live in the unhealthy state of South Carolina. We do not recognize that the market that used to be such an extraordinarily good one in this country has been worked and worked until there is no more market, and we still fail to recognize that almost across a ferry from Tampa, Fla., there is a large trade that is to be had for the asking if we simply go to the place and ask it.

If we can accomplish this extension of our trade through what we propose to do in the coming exposition, New England will participate in the result as much as North and South Carolina will. Any relief of the domestic market means relief to the cotton goods trade in all its features. I commend the Charleston Exposition to you.

The PRESIDENT. Gentlemen, we have listened with interest to the very able address of Mr. TOMPKINS. I should like very much to ask Mr. TOMPKINS some questions myself, but as the time is going so quickly, we will pass to the next paper, The Possibilities of Trade Expansion in Cotton Manufactures, by Mr. WILLIAM WHITTAM, Jr., of Knoxville, Tenn.

THE POSSIBILITIES OF TRADE EXPANSION IN COTTON MANUFACTURES.

WILLIAM WHITTAM, JR., Woonsocket, R. I.

Our Secretary, Mr. WOODBURY, suggested to me that in the preparation of this paper I should deal with the question of The Possibilities of Trade Expansion in Cotton Manufactures from the point of view of the practical manufacturer, rather than from that of the merchant or distributor of goods.

In doing so I must ask you to remember that it will advantage us but little to know the peculiar requirements of the several foreign centres, and how to most judiciously adapt our plants to produce the particular fabrics best suited to their tastes, unless we have some means of reaching these potential customers and inducing them to trade with us.

The first question that would occur to a manufacturer contemplating taking up the production of goods for foreign consumption would be, "What are the general characteristics of the goods in greatest demand in these exterior markets, and in what particular features do they depart most radically from our standard makes?" This inquiry covers a wide field and is much too involved a question to be covered in any but very general terms in a paper of this kind.

Speaking broadly, the standard makes of American cotton fabrics may be sold to a limited extent in most foreign countries, and in some few markets they can be disposed of in considerable volume — notably China and Mexico — however it can be positively stated that in the greater number of external trade centres our goods are too high in price, due principally to the fact that

they are "*pure sized*" *i. e.*, they are only given such treatment in the slashing process as will enable them to be easily woven, no attention being given to the addition of adulterants as such.

I am now speaking specifically of brown goods; the aggregate trade in this class of merchandise being very large.

The difference in cost between 6 per cent. and 100 per cent. of size in the warp will probably strike you more forcibly as a reason for our inability to compete more successfully than we do with our heavier goods, if you remember, that if this difference in weight should be made up with 32s yarn it would mean just about one cent per yard on the cost price of a fabric.

Thousands of looms in European mills are producing cloths containing in the warp 100 per cent. size and over, and these fabrics are all exported.

As an example of the regrettable condition of our export trade, in a country where we might have expected to make some impression; during the past year we only participated in the trade of Cuba in cottons to the extent of *five per cent.*, the average price paid for American goods being one-half cent per yard higher than that paid for fabrics of European manufacture, this difference in price against us was doubtless one reason for such a condition of affairs, although other reasons equally potent will, I am sure, occur to you.

We will not now consider the proper printing of fabrics, nor the bleaching and finishing of white goods to meet outside requirements, as these involve processes not generally found in our cotton manufacturing establishments, nevertheless the converting of cotton fabrics to meet the demands of the trade abroad will surely have to be seriously taken up at no distant date if we are to take the position of an exporting nation, which, by our natural advantages properly belongs to us. Favorable banking and freight facilities with this market are now ours, constant intercommunication and mutual interests bind us together, and yet, with all these accommodations, our proportion of the trade is so meagre as to be disagreeable to the cotton manufacturers and distributors of this country.

The goods sold most freely in foreign entrepôts outside those of the markets of the manufacturing centres of Europe may be conveniently divided into three classes, namely:

1. Heavy sized.
2. Medium sized.
3. Light sized.

Classes 1 and 2 are exported in the grey, while class 3, goods sized lightly, are usually bleached or printed after leaving the mill.

In a general way, class 1 may be said to include such fabrics as contain 75 per cent. and over; class 2 would include those containing from 20 per cent. to 75 per cent., while cloths containing less than 20 per cent. are usually known as light sized.

Before such fabrics can be produced satisfactorily by us, it is obviously necessary that we have some detailed knowledge of sizing materials and their application to, and retention by the warp.

There are many sizing compounds of more or less value offered to us; but, neglecting these, it may be said that sizing materials can be classified as:

Weighting,
Binding,
Softening,
Antisepic,
Coloring,
} Materials.

Without entering in detail into the properties of the many substances applicable in the sizing process I would direct your attention to the weighting material of chief value and in most general use, Kaolin or China clay.

The natural condition in which Kaolin deposits are found, and the facility with which such impurities as might destroy the value of the clay as a sizing ingredient may be eradicated are vital matters to be taken into consideration in determining the

suitability of any such deposit for the purposes under consideration.

The proper treatment of the crude material to bring it into the condition of a good sizing ingredient is thoroughly understood in England, but little if anything in this direction has been done here, it is, however, a fact that many beds of this substance are altogether unfit for sizing purposes.

Kaolin is found very extensively in different localities in the United States, many large deposits are known in the South. Some years ago I sent several specimens from deposits in South Carolina to England for examination as to their fitness for weighting purposes, and only one sample was reported as being of value for such use.

I would suggest that this Association collect samples of as many as is practicable of these clays, and have their sizing value determined by some competent authority, for I am convinced that the information which would be derived from such an analysis would sooner or later be of great value to many of our members. Many practical matters bearing on the sizing question in general, such as, size mixing; the duration, character and effect of the fermentation of the size on itself, and on the goods to which it is applied; the most suitable ingredient for giving any desired quality to the mixture; as well as the action of each ingredient on the several components of the batch of size, are both of much interest and importance, but cannot be inquired into at this time.

For obtaining the results necessary to successful heavy or medium sizing, the ultimate mixture must be composed of such ingredients as will give the desired proportion of adulterant, without much loss of material from the friction of the harness and reed in weaving; it should be so antiseptic as not to readily allow the formation of mildew in the finished fabric, it must also be so applied as to be thoroughly incorporated into the body of the threads, evenly distributed and impart to the finished fabric a nice clothy feel.

Many contiguous countries consume goods which are analo-

gous in construction, length, width, weight, color and design, similar packages being quite often equally well adapted for several markets; it is important when local peculiarities are once known, that they be rigidly adhered to at all times.

Having the data which as manufacturers we should need in order to produce the goods, one would naturally carefully examine the particulars to discover if any radical changes would have to be made in the machinery or equipment of the mill, to enable one to produce them.

Having in mind many of our Northern mills and a large proportion of the factories of the Southern States that are organized and equipped to manufacture coarse, heavy fabrics, it can be said that with a few inexpensive additions to the apparatus for mixing and storing the size, the heavily and medium sized grey goods so largely purchased by non-manufacturing nations can be made satisfactorily and profitably and at competitive cost.

Such fabrics contain a maximum of raw material, (cotton and size) and a minimum of labor is required in their production. Present conditions in the industrial centres of the South are more favorable for their remunerative manufacture than in any other manufacturing country in the world, with which we shall have to compete immediately we step outside our domestic market to dispose of the product of our looms.

For the warp of such goods as we are now considering, a hard twisted, solid thread is not at all suitable; a yarn with little twist, of an oozy character, made from a comparatively harsh cotton, will give much more satisfactory results as a carrier of adulterants, the size being better able to permeate the body of the thread, it is therefore retained much more tenaciously during the unavoidable chafing to which the warp is subjected throughout the weaving process.

An advantage which the Lancashire spinner has over us is found in the larger number of different varieties of cotton from which he can select; this also gives him a greater latitude in price, and in this way one can often lay down a mixing which is exceptionally well adapted for the particular kind of goods one

[illegible]

[illegible] no small portion of our mills [illegible] than is really necessary [illegible] which will compare [illegible] with similar goods made by our European competitors.

[illegible] the production of American [illegible] during the last decade may be noted.

[illegible] the present advantage we have in the [illegible] which the weaving labor cost [illegible]

I have in previous papers prepared for this Association and [illegible] with the [illegible] possibly re-[illegible] constant [illegible] matter to us. [illegible] finally [illegible] permanent prosperity. The [illegible] difficult to [illegible] under intelli-[illegible] the path of least resistance, and I [illegible] training in the marts of the world [illegible] anything but an easy one — our competitors [illegible]

To one who has closely watched the development and progress of our cotton manufacturing industry during the past few years, it is so palpably obvious that we must very soon enlarge the present outlets for our goods; or, with our rapidly expanding productive capacity have our business periodically suffer

from disastrous over-production and trade stagnation, and, gentlemen, it must never be forgotten that the vital interests of almost every member of this body are involved in the prosperity of the cotton industry.

During the past twelve months the State of South Carolina reached the second position as a cotton manufacturing commonwealth, Massachusetts being the only state having more spindles and looms, there having been installed in the former state during the year over *1,300,000 spindles.* During the same period *Alabama increased the number of her spindles by 61 per cent.,* and an approximately corresponding increment is found in most of the other Southern manufacturing States.

During a recent trip I made in the South, I found on a short branch railroad in Mississippi, three new mills and three additional ones projected. Need more be said of the importance of making the hundreds of millions of cotton-clad foreigners our customers?

Curtailment of production in Fall River has become almost chronic, and no effort is apparently being made to avoid these shut-downs in the future.

In a paper on "Latin American Trade in Cotton Fabrics",* which I recently presented to you, the construction of the standard English print cloth was given. Comparison will show that it differs in the two very essential particulars of width and weight from the standard American fabric. If our printers had similar goods, their export trade could be very considerably augmented, especially if their colors and designs met the tastes of the export trade.

The last issued volume of the monthly Consular Reports,† in which appears the report of the United States consul at Manchester, England, on the exports of cotton goods by all manufacturing countries to South and Central America, furnishes much interesting, if unpalatable, reading for us.

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*Transactions New England Cotton Manufacturers' Association, Vol. 68, page 145 April 25, 1900.

†August, 1901.

The cotton trade of the world is as yet practically untouched by us, while we keep on building new mills and enlarging existing ones at a great rate, and meanwhile we are doing practically nothing at all to enlarge our market for the goods made by these additions to our industry.

Travelling Americans are frequently amused at the crude agricultural implements used by the peons of South America and the agriculturists of the Orient, although the business acumen displayed by us up to the present, in the way of protecting ourselves from over-production, is not one iota more advanced than are the crude appliances I have mentioned.

Ability to produce the goods profitably at level prices, natural advantages, reciprocity treaties, the construction of a canal connecting the Atlantic with the Pacific, ocean shipping under our own flag, international expositions, banking facilities abroad, are all of much importance and would be materially helpful to us, and we may have all these advantages in the not distant future, but in so far as our own particular welfare is concerned, they will profit us but little unless the man who buys the goods is reached and our wares insistently brought to his notice. Competent salesmen we must have; men with a practical and technical knowledge of the goods they carry, capable also of collecting information bearing upon the peculiar needs of each market visited.

The trade cannot be reached without expense and systematic effort. Should, however, several corporations syndicate their interests and sent out such a man as I have described, the expense would not be heavy for the several members of the combination and the benefits that would ultimately accrue to them would most assuredly warrant the outlay.

The South compelled our producers of iron and steel to seek an outlet abroad, and this experience will most surely be repeated in our case. Perhaps we shall move slowly along, suffering our expensive equipments to remain idle for gradually lengthening periods, and in fancied impotency wait for another "boom"; or on the other hand we may, by having our atten-

tion forcibly and frequently directed to the "way out", adopt the only means of ridding ourselves of the continual and growing menace of over-production and ruinous competition in the home market.

The present Pan-American Exposition of the resources of our Continent cannot but impress us with the wonderful wealth of our sister republics. I have visited many of them and have always enquired as minutely as I could into their needs, tastes and capacity as possible users of our cotton textiles.

We are now by far the most important customer of most of them, purchasing their products freely. Our matutinal cup of coffee, the chocolate we lavish so freely upon our families, and many other articles of daily consumption and use, are sent to us by our Southern neighbors, while they take much of the money with which we pay for these wares of theirs and send it to England, Germany, France and other European countries to buy the cotton fabrics which they wear almost altogether, and which we might just as well send them.

Their countries are being gradually developed, their purchasing power is increasing from year to year, and we can supply their needs as fully and as cheaply as any other nation. It behooves us, therefore, to make a determined and continued effort to do so, and we shall then enlarge the measure of our own prosperity, and can increase the number of our mills without fear of glutting the domestic market.

The PRESIDENT. The next paper on the programme is Modern Boiler Problems, by Col. E. D. MEIER of New York. Col. MEIER was formerly secretary of the American Boiler Manufacturers' Association, and ought to know what he is talking about.

MODERN BOILER PROBLEMS.

Col. E. D. MEIER, 11 Broadway, New York, N. Y.

With the increased demand for steam power in every old line of manufacturing and in many new ones, problems in boiler design and construction arise, which compel departure from many old and at one time generally recognized standards. For many years the boiler was considered simply as a part of the engine and no one thought of treating it as a separate entity, to be constructed by specialists. But during the last twenty years, the development of boilers has gone on separately, and to find a machine shop which builds engines also engaged in building boilers, heaters and other accessories, is the exception and not the rule.

IMPORTANCE OF THE BOILER.

Naturally enough, then, there was formerly very little attention paid to details of design and to the inter-relation of various parts in the boiler, which now command the most serious attention of specialists. It is just as necessary to have a clear understanding of the various functions and their dependence on each other in a boiler as in a steam engine.

In fact, I may be pardoned for claiming that, in one sense at least, the boiler is the more important of the two. Engines have been carefully constructed with variable automatic cut-offs, so as to consume in each minute just the quantity of steam needed, thus accommodating themselves to the ever varying demands of the machinery they drive. Very few steam users, however, consider that where there is such an exact system of checks and

balances, there must be some source of supply for power which is adequate to meet all these varying demands. The boiler with its furnace and chimney furnishes this source and it may be news to many of my hearers that in some plants the demand upon it varies sometimes fully fifty per cent. within less than half an hour. This is especially the case in such plants where live steam is used for other purposes besides driving the engines, as in tobacco factories, breweries, etc. Thus in the end the boiler must make up for all deficiencies and all variations in the entire plant and is therefore deserving of greater consideration than it has received in the past.

OLD RULES AND RATIOS BECOMING OBSOLETE.

Many rules and ratios which were fixed by certain old authorities on steam, whose memory we revere though we deem it unwise to follow their dicta, may no longer be applied without hesitation. In fact, it would be an injustice to those old authorities who based their conclusions, no doubt conscientiously, on facts as observed in their day. With increased demands the facts have changed and the rules must be modified.

Besides, furnaces and boilers must now be separately considered, furnace capacity and efficiency and boiler capacity and efficiency being two different elements of the problem and not to be confounded. In our old practice, say not more than twenty years back, and in some localities even more recently, we find that 8 pounds of coal burnt per square foot grate area per hour was considered about normal, while 15 pounds represented forced firing. This was in the days when we carried 50 to 60 pounds pressure, and thought we had excellent draft from a stack 50 feet high. Today we have many plants in which 20 to 25 pounds per square foot grate are required in regular service and 35 to 50 pounds in forcing, while pressures have risen to 150 and even 200 pounds and stacks are built 200 feet and over. I call attention to the stack of the Coates Thread Works at Newark, N. J., which is 335 feet high and one recently constructed in Germany, 420

feet high. Among other things, a good old rule quoted as to fixed relations between grate area and heating surface must be relegated to the limbo of things that have been. It was a very good one when applied to known and very limited conditions and when one pound of coal meant practically but one thing to a limited manufacturing community, but we have now to consider steam coals varying from the excellence of the Welsh anthracite (really almost a semi-bituminous coal) to the lignites of Texas or Colorado, which have less than one-half its evaporative efficiency. It is perfectly plain that as heating surface is intended to absorb and transmit heat which has been engendered, its efficiency must be the first consideration. The rapidity with which a square foot of heating surface will transfer a certain quantity of heat from the hot gas on one side to the hot water on the other side, depends mainly on three conditions.

First, on the difference between the temperatures of the gases and the water. The greater this difference the more rapid the transfer of heat.

Second, on the circulation of the water on one side and of the gas on the other, for if either stagnate it will soon form a film of practically equal temperature on one side of the metal which is a very slow transmitter of heat; but if the circulation of both be good, new strata of gas and water will be constantly presented to the heating surface, and therefore the transfer of heat will take place under the best conditions.

Third, the transfer depends on the cleanliness of the surface. A sixteenth of an inch of boiler scale will have a large effect in reducing the rapidity of the transfer of the heat, and a covering of ashes or soot on the outside of the tubes will be still more effective in reducing this efficiency.

OLD DEFINITIONS MISLEADING.

From the old practice of considering the boiler as part of the engine we have carried over at least one designation which has become an absurdity. I mean the term horse power as applied

to a boiler. It is a convenience mainly in serving to cover up the fact that the exact requirements in a steam problem are unknown and that the purchaser wants the contractor to do the guessing. Engine builders know, and those who build good engines are glad to guarantee, the number of pounds of feed water (or steam) their engines require per horse power hour. A first class reheating compound engine is content with 13 pounds per hour while such auxilliaries as chief engineer White found on the U. S. S. Minneapolis, demand 225 pounds. This is too wide a margin for the shrewdest Yankee guesser. And such "steam chewers" are also to be found in many fine plants on shore where the treasurer does not suspect them, though he may have put them there himself in mistaken economy of first cost of installation. Their demands must be determined and added to that of the main engines and the total expressed in units of evaporation to define the boiler problem with that precision which characterizes your mill statistics in other matters of like importance. As the necessity of accurate statement is recognized in all engineering matters the American Society of Mechanical Engineers has recommended two units of measurement which have been adopted by the common consent of steam engineers.

The unit of evaporation (U. E.) is defined as the evaporation of one pound of feed water from 212 degrees Fahrenheit to steam at atmospheric pressure, or more succinctly stated as "the evaporation of one pound of water from and at 212 degrees Fahrenheit."

The horse power is then defined as the evaporation of 30 pounds of feed water from a temperature of 100 degrees Fahrenheit to steam at 70 pounds gauge pressure, which is equal to 34.48 units of evaporation or in round numbers 34½ U. E.

This latter was first adopted as a makeshift at the Centennial Exposition in 1876, and its very definition shows its inadequateness and clumsiness as applied to modern conditions. While the U. E. plainly states a perfectly natural and fixed relation, the term H. P. as applied to boilers proclaims its own absurdity.

For with modern feed water heaters interposed between cylinder and condenser and drains from jackets led to the feed pipe, we no longer reckon with hot well temperatures of only 100 degrees or 110 degrees in our feed. When we carry from 160 pounds to 200 pounds of working steam pressure the reference to "70 pounds guage pressure" loses its practical significance, and there are other times and places for the study of the ancient history of the steam engine.

If we desire to show our highest appreciation of the very eminent engineers who fixed the "Centennial Standard", in 1876 by the "sincerest flattery" of imitation, we should now, a quarter century later, define our boiler horse power as 15 U. E., thus fixing as they did a landmark of progress in steam engine practice for our own day.

To me the only rational method seems to abolish the term horse power as applied to boilers altogether and to state how many units of evaporation the boiler is to furnish as its normal work; this, with the one-third margin recommended in the Code for Boiler Tests of the American Society of Mechanical Engineers, would provide a fair and precise basis for purchaser and builder alike. And the principal difference between fair trade and gambling is that in the one the conditions are known and frankly stated, while in the other they are uncertain and hidden.

This plan throws the burden of establishing the facts on your consulting engineer and that is what you pay him for.

DESIGN OF THE BOILER PLANT.

As all the important boiler works now employ specialist engineers either permanently or as needed, there no longer exists a necessity for the consulting engineer of a mill to prescribe details of design in a boiler or furnace. His business is primarily to state your requirements in plain words and exact figures, and secondarily to exclude designs or apparatus which in his best judgment, are unsuited to your conditions. There is no more reason for him to indulge in boiler or furnace design than in engine design. A structural engineer states what

physical and chemical qualities his material must have and leaves the manufacture to the steel maker. In like manner, when capacity, economy and quality of steam have been specified to the boiler maker, his judgment and experience should have free scope to design the plant to surely fulfill these requirements.

The man who designs must be held responsible for the results. Hence, when special furnaces, automatic stokers, or artificial draft are required, a further division of responsibility must follow, both to avoid mistakes and injustice, for in the physical as in the spiritual world every one of us is accountable for his own deeds, and requirements of contracts in defiance of this natural law are more apt to lead to lawsuits than to correct design and satisfactory plants. Arbitrary specifications as to quantity of heating surface or grate area may lead to deficiency for one or surplusage for another.

A wise old saw is to always insist on the largest possible heating surface. Yet there are many examples of increased steaming capacity resulting from removal of an entire vertical row of tubes in a horizontal tubular boiler, the increased circulation more than making up for the surplus heating surface which clogged it before. And the experiment on the Illinois Central R. R. of some 15 years ago proved that a combustion chamber obtained by sacrificing ten times its own heating surface in the shortened tubes resulted in increased capacity and economy. And who is not familiar with the futile attempts at correcting too great tube area in fire tube boilers by means of retarders placed in the tubes because the gases refused to recognize as heating surface much so called in incorrect design, and "short circuited" to the flue. Similar effects have been noted in water tube boilers.

In the old days we used to hear much talk of "effective" heating surface, and there were empyrical guesses stated as facts by "authorities" as to the relative effectiveness of vertical, horizontal, upper and lower segments of heating surface. Nowadays we recognize as engineering facts only such data as rest on

actual [illegible]ents and observations and on a large number of these.

In this wa[illegible]e have learned that circulation both of the water and the gases increased the effectiveness of heating surface, and is hence as important a consideration as the quantity of the latter.

Every builder of water tube boilers recognizes this circulation as a necessity and provides for it in details of design. The relation of areas for circulation to amount and location of heating surface and to grate area and draft must be found by every builder for his own type before he can confidently design his boiler to meet given requirements.

To impose the ratios found by one on any and all others by specification is not engineering but ill considered tyranny. The greater the difference between the temperatures of water and gases, the more rapid the transfer of heat and hence the greater the effectiveness of heating surface. When this difference drops to less than 200 degrees Fahrenheit the value of additional heating surface in the boiler becomes nil and the economizer finds its proper place and becomes useless in turn when this difference again sinks below 200 degrees.

We need then, a well designed furnace with enough, not too much or too little air, and a firebrick combustion chamber in which air and gases mingle at high temperatures and complete their combustion before both are cooled by contact with the heating surface.

RELATION OF H. S. TO G. A.

From the above considerations it is plain that this ratio must be variable according to fuel and draft. As volumes of gases vary only about 11 per cent. between anthracite and low grade bituminous, and less than 5 per cent. between New River coal and the latter (see table 63 Helios), the areas for circulation of gases are practically independent of the grate area or the kind of coal; and as we can maintain nearly equal furnace temperatures, neither will the heating surface require rearrangement.

This conclusion may be plainly stated thus. We must provide grate and draft enough to burn a sufficient quantity of the coal which is to be used. If we do this the flue areas and heating surface need not differ materially from our previous best standards.

Therefore, to state that for a poorer coal you must have a larger boiler argues a confused view of the problem. There are hundreds of tests available to guide us in estimating the quantity of coal necessary to produce the required amount of steam. From them we learn also how much we can burn per square foot grate. After full consideration the American Society of Mechanical Engineers recommended as a basis for a fair rating of boilers, their capacity at good economy without forcing fires with the *best coal ordinarily sold in the local market*, and with a margin of one-third over this rating when forcing fires, with draft at least one-half inch water column.

When slack coal, screenings, run of mine, pea, buckwheat and rice coal are the fuels selected, a boiler rated as above would fall far below this rating in actual service, and the erroneous statement above referred to is heard.

The boiler, however, is of same capacity as before; your wagon holds its ten bales of cotton just the same even if the team is too weak to pull it. Try a stronger team before you change your wagon.

We find that with best bituminous coal we can count on 10¼ U. E. per pound; with anthracite egg on 9½; with pea coal on 8½; with buckwheat 7½; with rice coal 7; all for good coal of these kinds running less than 20 per cent. ash.

We know that in practice we burn, per square foot grate, 24 pounds of good bituminous coals, 20 of anthracite egg, 18½ of pea and 16½ of buckwheat and 15 of rice coals. For these latter we must count on at least seven-tenths inch draft and may not go much over one inch for fear of blowing much unburnt coal off with the ashes. Putting these quantities together, and retaining for the nonce the unfortunate designation of H. P., we find that we can count per square foot grate on 7.1 H. P. for

best bituminous; 5.8 for egg; 4.4 for pea; 3.6 for buckwheat; and 3 H. P. per square foot grate for rice coal. Hence if you have a 300 H. P. boiler every day giving its rating on bituminous coal and you change to buckwheat coal, you must not exact more than half rating unless you double your grate area. But the boiler remains as before a 300 H. P. boiler.

As there is a practical limit to the length of grate which a fireman can manage, it finally becomes a question of width of furnace. And in placing the proper amount of heating surface over it, we come to a low, broad boiler for the low grade anthracites and a high narrow boiler for the high grade bituminous coals.

Remember that anthracite coal was barred from locomotives by this consideration until the invention of the Wooton fire box made a wide grate possible.

To change then from bituminous coal to buckwheat or rice coal involves much more than a mere consideration of relative prices per ton. It becomes a question of kind and length of grate bars, width of furnace and amount of draft, and means, therefore, a permanent change in the boiler plant.

Much ingenuity and experiment has been devoted to the development of automatic stokers for these low grade anthracite coals and as they have successfully handled grates two or three feet longer than can be fixed by hand, and have burnt up to 22 pounds per hour, they present the possibility for permanent adoption of the cheaper fuels without increase or complete change in the boiler plant.

CONSTRUCTION OF BOILERS.

Closely allied to questions of design are the materials and methods of construction. These have been steadily improved and made fit to meet the most exacting modern demands.

Boiler iron is a thing of the past. Tensile strengths of 48-50000 pounds in charcoal iron have risen in best homogeneous steel to from 60-65000 pounds with ductilities even greater than those formerly attained. With such plate and small drums

almost any pressure can be met. Since 1889 the *American Boiler Manufacturers' Association* has been active in the work of improvement of boiler materials, keeping in close touch with the steel makers. Judiciously demanding no more than good practice could furnish but insisting on actual physical and chemical tests in place of relying on mere brands, no matter how celebrated, they found that the steel makers, in their natural anxiety to fill these moderate specifications generally exceeded them. (See Report Proceedings A. B. M. A. 1897.)

From the start cast iron was condemned as an unfit metal for any part of a boiler subject to tensile stress. And good flange steel has taken the place of all parts formerly made of cast metal, the only excuse for the use of which was the ease and cheapness with which it could be formed into more or less intricate shapes without skilled labor. But with hydraulic presses and drop forging even this excuse falls, and the better material should be insisted upon.

During eight years committees of this Association were busy in collecting facts regarding the best practice in manufacture and workmanship of the leading boiler works of the United States and Canada; included as part of this work was the testing to destruction of seven drums or shells built by as many different firms of A. B. M. A. steel. These tests took place in Chicago in 1893, and demonstrated practically the effect of different methods. A full discussion of them at subsequent conventions (participated in by U. S. municipal and insurance inspectors) showing wide departures from older boiler practice and proving many time honored rules to be obsolete, a strong committee was appointed at the Philadelphia meeting in 1897 to formulate best modern American boiler practice in a set of rules.

These were presented, fully debated, and unanimously adopted at the Tenth Annual Convention in St. Louis in 1898 as the *Uniform American Boiler Specifications.* (See A. B. M. A. Proceedings 1898.) Copies can be obtained of the Secretary of the Association. These furnish a safe basis for specifying the

best construction for a contemplated plant, since they ensure the use of modern American materials, tools and methods, developed under existing conditions of high pressures and high furnace temperatures.

CONCLUSIONS.

The exigencies of modern steam practice demand concentration of the power producing plant in minimum space.

The grate area being limited in length by practical conditions, we must utilize every inch of width. With low grade fuels this width becomes the measure of the power which can be produced. Heating surface must be disposed with reference to this width. For this the watertube boiler is most adaptable. Internally fired or underfired shell boilers have not this flexibility of arrangement.

For high pressures, the best, most tenacious and most ductile materials must be used. There are defined in A. B. M. A. specifications which cover also the best practice as to constructive details.

Small and mainly cylindrical parts with all pressures internal best withstand the high tension of steam now demanded. Large shells present greater structural difficulties and collapsing stresses must be avoided. This again militates against fire tube boilers where external pressure subjects the tubes to deformation and collapse and where larger units require great diameter of parts, while the water tube boiler meets all these requirements.

Greatest economy requires high furnace temperatures attainable only where the cooling of the gases by the heating surfaces can be deferred till the combustion is completed. This excludes internally fired and underfired shell boilers and gives preference to the water tube type.

Rapid steaming requires large and effective liberating surface presented in almost ideal conditions by the unobstructed and rapidly moving water level of the sub-horizontal water tube boiler; vertical boilers of any type are precluded by this condition.

For cleaning the tube heating surface both inside and outside, *i. e.*, removing both scale and ashes, the water tube boiler with straight tubes, is immeasurably superior to all fire tube types.

The universal adoption of straight tube sub-horizontal water-tube boilers by all the navies of the civilized world corroborates the statements above made, and for the same reasons cotton mills will naturally follow in the wake of the electrical and milling industries in adopting these truly modern steam producers.

Mr. F. W. DEAN. I have read Col. MEIER'S paper on Modern Boiler Problems and regret that I am unable to agree with him on several important points.

I shall pass over the remarks concerning old rules and ratios, for although some of them are illogical at the present time, they are fully understood by engineers and do no harm.

Among the things said in the paper, I am particularly interested in the remark on the bottom of page 314, which is as follows: "Third, the transfer (of heat) depends on the cleanliness of the surface. A sixteenth of an inch of boiler scale will have a large effect in reducing the rapidity of the transfer of the heat, and a covering of ashes or soot on the outside of the tubes will be still more effective in reducing this efficiency."

I also am interested in the next to the last paragraph on page 323, which says: "For cleaning the tube heating surface both inside and outside, i. e., removing both scale and ashes, the water tube boiler with straight tubes, is immeasurably superior to all fire tube types."

I can hardly imagine any other statement than that last quoted from the maker or salesman of a straight-tube water tube boiler, but I have heard as strong statements made before a similar

Association to this, in favor of a water tube boiler having bent vertical tubes. I hope, however, that the members of this Association who are interested in boilers will carefully consider the cases on their merits and see whether a straight fire tube cannot have its interior blown out by a steam jet with positive knowledge that it must go where it is needed and be so confined that it will sweep every part of the interior, and thus do all that such a jet is intended to do. I hope they will also consider whether a steam jet among a lot of water tubes does not by its hit or miss course and lack of confinement fail to do anything but remove the more superficial layers of dust from the tubes. I hope they will consider still further whether there is anything in the methods of cleaning the fire sides of water tubes that is akin to, or that at all compares in effectiveness with the use of a scraper in fire tubes, by means of which the soot and ashes can be completely dislodged and cleaned out, and thus can this obstacle to the transfer of heat, soot, which Col. MEIER describes in the first quoted paragraph as the worst that can rest upon a tube, be removed. In view of this, how can the words, "immeasurably superior" in the last quoted paragraph be justified, when water tube boilers are thus so plainly inferior in the respect discussed?

In regard to cleaning the inside of water tubes and the outside of fire tubes, the former can be bored, or cleaned by a small power hammer,* both of which processes are used. This same power hammer run through fire tubes cracks all scale from the outside of the tubes and it falls to the bottom of the boiler whence it can be easily removed. I have seen this done most effectively, and there is no obstacle to the progress of the hammer, while in water tubes the scale, if at all thick, is quite an obstacle.

The adoption of water tube boilers in navies is often quoted as an argument in favor of their adoption on land, but the argu-

*This is the Dean boiler tube cleaner, but I wish to explain that it was not invented by me, nor by any family connection.

ment is misleading. The water tube boiler in a war vessel is wanted because it is lighter than the regular marine fire tube boiler and can readily have more grate area. In these respects the water tube boiler competes with a type of boiler which is the heaviest in metal and water of any fire tube boiler and in which it is very difficult to obtain sufficient grate area to go with the heating surface.

On land every type of water tube boiler that I have examined contains more water in proportion to the heating surface than the common horizontal return tubular boiler, although less than vertical fire tube boilers; thus the argument of lightness, which is effective at sea, fails on land when it is applied to the most common land boiler. It should be noted also that this fact of water tube boilers containing more water than horizontal return tubular boilers shows that the common argument that they are more responsive to sudden demands than the latter is fallacious.

One of the conclusions on page 322 of the paper is that more boiler power can be placed in a given space with water tube boilers than with fire tube boilers. This is open to argument, and I will state that Dean & Main have designed horizonal return tubular boilers and placed over 16,000 square feet of heating surface and 252 square feet of grate area in a width of 46 feet, 6 inches, including brick work, rated at 1,600 boiler horse power, and worked up to nearly 3,000 horse power night and day. I do not think that this has been equalled by water tube boilers. Moreover, by the use of vertical fire tube boilers double the power obtainable by horizontal water tube boilers can be placed upon a given floor space, although of course the height occupied is much more.

The fourth conclusion relates to the perfection with which water tubes stand up to their work and the corresponding defects of fire tube boilers. There are many people that are so familiar with the explosion of water tubes that they fear to stand before a boiler possessing them, lest they should be buried under a mass of incandescent coal and scalding water, for the effect of such a disaster is frequently to pitch the contents of the

fire box on the floor, and of course, always to empty the boiler of water.

There have been a sufficient number of drum explosions of water tube boilers of the most disastrous kind to show that there can be nothing worse. It is true also that there has never been an explosion of a horizontal return tubular boiler that has been built with the longitudinal joints butted, and since the effect of failure of fire tubes, which very seldom occurs, is only to allow a small stream of water to run out where it can do no injury, it is evident that this type of boiler is the safer of the two, and should have the better reputation for safety. It is only the lap joint boiler that explodes, and the lap joint in the drums of water tube boilers will cause them to explode also.

The conclusion that greatest economy requires high furnace temperatures and that these can only be obtained in the brick furnaces of water tube boilers is contradicted by the results of tests, the highest results, except in two or three special cases, having been obtained from internally fired boilers. It is commonly stated that the highest furnace temperatures are necessary for complete combustion, but this is not true. A temperature sufficiently high to burn carbon to carbonic acid is all that is necessary, for nothing more is desired or sought, or would do any good. Gas analysis show that this is obtained in one kind of furnace as well as in another. No mention is made in the paper of the fact that in water tube boilers the flame passes around and between the tubes and therefore has the same chance to cool below the temperature of combustion as in the case of other boilers. In the Colonel's boiler it may be rather less so than in some others, but if it is so it is due to the lower row of tubes being imbedded in tiles and clinker, in which event they are inferior as heating surface, but are nevertheless counted in.

The conclusion in regard to large liberating surface being necessary for rapid steaming I have not found to be true. The Manning boiler has the least liberating surface, but they have been forced in regular service without disadvantageous results. Surely no type of boiler has a worse reputation for sending over

water with steam than the water tube. I wish to add, however, that I have not in general found that reputation merited.

Concerning the claim made in the paper that special designs of boilers are not justifiable, I wish only to say that circumstances alter cases.

Col. E. D. MEIER. There are two principal points made by Mr. DEAN to which I wish to reply. The first one refers to cleaning by steam jets. The method of cleaning the inside of a fire tube with a steam jet is to put the steam jet generally at one end — there are various kinds of steam jets made, some with a whirling motion — and blow the soot out. That can best be accomplished, however, by passing this through the entire length of the tube. That, you will understand, is a very difficult thing to do in a fire tube boiler. I, myself, long before I built any water tube boilers, experimented with that and found it a very difficult and very unsatisfactory arrangement. There is another point about it, that if you take a steam jet, even with a hundred pounds pressure behind it, you will find that even at a distance of about three feet from the nozzle it loses its effect. The steam expands very rapidly, and loses its speed and at the same time loses its weight, and consequently the total effect is very slight.

Now, as Mr. DEAN has forced me to speak of my own boiler, which I had not intended to do in this paper, I will say that I did of course have it in mind. In the Heine boiler we clean by means of a steam jet. The farthest distance that the jet has to travel before striking the surface of the tube is less than six inches, and we drive it along the whole length of the tube, at the same time turning it so that we have the advantage of striking four or six tubes, and all within a distance of six inches, the nearest one an inch and a half. That is a much more convenient way of cleaning off soot than trying to do it from a long distance. The advantage, furthermore, is that we can clean while running, whereas if you want to thoroughly clean a horizontal tubular boiler you have to shut down altogether, or at least

curtail the performance very materially while you are doing it, because you open the tubes to the entrance of cold air.

Now he speaks of the Dean power hammer, which he claims can be run on the inside of a fire tube and crack off the scale on the outside, and he says "I have seen this done effectually." Now I beg you to remember that no one can see this done effectually unless he gets inside the boiler. The idea of standing outside and having some one show you a little scale that falls down does not prove that you have knocked all the scale off; and any one who has had to do with hard scale will consider that about as effective a means of cleaning the outside of a tube by hammering on the inside as it would be if I suggested to these ladies to clean the outside of their windows by tapping gently on the panes from inside the room. It would have about the same effect.

In the next place, Mr. DEAN speaks of "the bias of a maker," and I will state that I plead guilty to that. I would not stand here before you speaking of a water tube boiler and praising the water tube boiler if I did not thoroughly believe in it; and if that is a bias it is a bias that I am proud of, and every one of you, I suppose, is proud of what he considers the best efforts that he can put into his work. But that point, and also the point made towards the end of the paper, in which he speaks of the danger of standing before water tube boilers on account of the frequent bursting of the tubes, shows conclusively that I was right in saying that it is better not to let your consulting engineer design your boilers, any more than it would be wise to let him design your engines for you. The feeling which is expressed there and the manner in which it is expressed is so much stronger and so much more polemic than we would allow our salesmen to use that it shows the animus very plainly. The fact is that Mr. DEAN is the father of a boiler known as the Dean boiler, and if he would come out as the manufacturer of that boiler we would meet him on even conditions. But when he acts as consulting engineer, and then speaks of his boiler in that way, he is at a point where we cannot reach him.

He speaks of the reasons in the navy for adopting water tube boilers, and says furthermore that the same reasons do not exist on the shore. Now I had merely mentioned the navy, not wishing to go into greater detail and so swell the volume of my paper; but I might have said and will say here that all the large electric power plants and stations which have been built in New York, Philadelphia, Chicago, Cincinnati, St. Louis, San Francisco and a number of other large cities, use water tube boilers exclusively. There have been within the last two years four of the largest power stations of any kind in the world, either built or now building in New York, for which water tube boilers only were considered, and that for the very reasons I have given in the conclusion of my paper. That is, because the engineers there recognize the saving of space, the ease of repairs, the facility of cleaning, the economy, the safety at high pressures, as all being in their favor. If it is fallacy to suppose that water tube boilers respond to sudden demand, why is the use of water tube boilers not only general but exclusive in such types as require rapid steaming — steam fire engines or automobiles, for instance?

Coming back to the navy I wish to mention a circumstance in connection with that celebrated "Loop." At the time of the battle of Santiago, the only vessel which had all its boilers under steam was the Oregon, and that is the reason she made that wonderful burst of speed. The Brooklyn had only half her boilers under steam. What I state now I state from positive information obtained from an engineer of the Brooklyn soon after the battle. He said they had the strictest orders never to attempt to raise steam in those large fire tube boilers they have in the navy in less than six hours, and under the stress of circumstances and considering the emergency demanded it, they did raise steam in the spare boilers of the Brooklyn, which were standing there with cold water, in three hours. Now with a complement of water tube boilers they could have had full steam on them all in 30 to 40 minutes.

Mr. DEAN further tells you that the usual type of water tube

boiler has more water in proportion to the heating surface than the fire tube. This is certainly news, and contradicts statements to the contrary by Professor THURSTON in his work on boilers, and I know of many fire tube boilers which corroborate THURSTON. However, it is a fact that in many fire tube boilers, as I mentioned in my paper, there has been an excess of heating surface which could not be utilized by the quantity of fuel that could be burned in the furnace; therefore, in such boilers as that, he may find that condition, but that is wide of the mark. However it may be, as to heating surface, for the power of the boiler, the water tube boiler has less water than the fire tube.

Then another thing, more heating surface is required in the fire tube boiler than in the water tube boiler. That is shown by the rating given by the different makers.

Right there I will touch on the question of entrainment. It is a well known fact that within the last six or eight years the specifications of engineers, notably in large electric light and power plants, have changed in regard to the matter of entrainment from permitting three per cent., which was common with fire tube boilers, to limiting it to less than one per cent. with water tube boilers. I say that for my rivals' as well as for my own.

Mr. DEAN then doubts my statement that more power can be put into a given space with the sub-horizontal water tube boilers than with any other, and he comes to a personal matter there, stating something what his own firm has done. Now taking his distance there, 46 feet, 6 inches, I will allow that he must have at least, for that type of boiler, four boilers, which would give him a boiler nearly ten feet in diameter, and allowing 18-inch walls it would leave him about 39 feet of aggregate furnace width. But to get 252 square feet of grate area his grate bars must have been 6.46 or nearly 6½ feet long, which is about as long as I deem it wise to put in grate bars where they are firing bituminous coal, because the fireman has to have a chance to handle it, and the length of the fireman's arm and his

strength has a great deal to do with the length of grate bars that you can put in. I can put in the same space water tube boilers having 40½ feet of aggregate furnace width, which with the same length of bar would give me 262 square feet of grate area, or ten feet more than he has. And according to my figures for bituminous coal, I would get 1,860 horse power against his 1,600.

As for the amount of heating surface, I do not see how that can be questioned at all, because if you will imagine a fire tube boiler of ten feet in diameter, you cannot fill the whole of that with tubes; you must leave about one-fifth at the top for your steam space. Now you cannot get as many tubes into that entire circle as I could into ten feet square, because in a water tube boiler I can use every square inch there is to put the tubes in, consequently in the same space I can put more tubes. In other words, the water tube boiler is so flexible — you can build it high and you can build it wide — that you can put more tubes in it than you can in the horizontal tubular boiler, which is necessarily confined to a round shape.

Then in regard to disastrous explosions, it is well known that the greatest authority in regard to explosions is the Hartford Steam Boiler Inspection & Insurance Company, which has been in the business longer than any other, and their business extends over the entire United States. They have direct cognizance through their own losses of only the best of the fire tube boilers and the best of the water tube boilers, for in fact there are very few water tube boilers insured, except by large companies who find it very important and good business policy to insure their boilers in the Hartford Steam Boiler Inspection & Insurance Company and to have their inspection. If you will refer to the Hartford Steam Boiler Inspection & Insurance Company, any one of you, you will get the straight information. They will not give anything for publication, but you can get the facts at any time. And I venture to say that you will find — in fact, I know that you will find — that there are at least twice as many losses to pay on the best fire tube boilers as

on all ter tube boilers, good, bad or indifferent; and furthermore, when it comes to entire ruptures and disastrous explosions, it is about as 50 to 1. Then you have to include a great many boilers which are not insured in the Hartford Steam Boiler Inspection & Insurance Company. I took the trouble to make up these statistics some years ago, and I found that to be the case. And the conclusions I came to were at that time published by the American Boiler Manufacturers' Association, being given in detail. (See Proc gs, 1897.)

To sum up, there are recorded in th 10 years from 1886 to 1896 but *13 partial* and *3 total* explosions of water tube boilers, as against *101 partial* and *2,340 total* explosions of fire tube boilers. This contradicts Mr. DEAN'S statement somewhat drastically.

Then he says that no boiler has ever exploded except a lap joint boiler, and places such tremendous stress on the butt joint. That is an entirely theoretical consideration, but is not borne out by the practical facts. In my paper I refer to certain tests which were made in 1893, at the time of the World's Fair in Chicago, by the American Boiler Manufacturers' Association. Seven drums built by seven different firms of the same American Boiler Manufacturers' Association steel and each built according to the ideas of these different boiler makers, were tested to destruction, and no such superiority of the butt joint was found. In fact, the common idea of the parting of a joint by the shearing of the rivets or tearing off the sheets was completely exploded. That is not the way the boiler gives way at all when it is destroyed. It gives way in an entirely different manner. It is what was named by Mr. H. S. ROBINSON of the Atlantic Works the "claw hammer" action. That is, as the boiler expands it pulls this way [illustrating] like a claw hammer, and it pulls the heads off the rivets. And we found in that way that the much-vaunted practice of drilling the holes for rivets is not correct. The rivets that were put in in well punched holes stood the best, gave the best results, and among those there was one triple-riveted lap joint that gave the most perfect satisfaction and stood more than any

other part of the boiler. That is very interesting reading, resting entirely on practical observation and not on theoretical rules. The trouble with boiler specifications in the past has been that they have been based only on theoretical considerations and not on tests made with full sized drums as we had them there.

Now in speaking of his being able to place double the power in the same space by using a vertical fire tube boiler, I must contradict him there from my own experience. The Municipal Electric Light and Power station in St. Louis contained 20 vertical boilers, which were combined fire tube and water tube boilers, so ought to have the advantage of both — in fact, had an enormous amount of heating surface gained in that way. They were rated at 300 horse power each, making a total of 6,000. I replaced these 20 boilers with 12 boilers of 375 horse power each, making 4,500 horse power, and had space left for four more; but the 4,500 horse power Heine boilers easily did the work which it was difficult for the 6,000 horse power vertical boilers to do. There was a point that came out in the laying out of that plant, and is a very interesting illustration of this fact, — that you have got to get to your boiler to fire it. If you put in a vertical boiler that is very large you must have more than one firing stand, and you must have room for the fireman to handle himself, and thus require more room for the vertical than for the horizontal boiler. We fill every inch of space. You utilize only a circle but you must count on the whole square, which is of no use to you except where you put your fire doors, and there you must have room for your fireman. Now by putting in two lines of horizontal water tube boilers and using the space between for the firemen, we economize the space so that we have been able to put actually more power into the same space than could be done with vertical tubular boilers.

I will say that I have copies of the uniform specifications of the American Boiler Manufacturers' Association here. If any one would like to have them I will turn them over to the Secretary.

UNIFORM AMERICAN BOILER SPECIFICATIONS

ADOPTED BY THE AMERICAN BOILER MANUFACTURERS' ASSOCIATION.

(See Proceedings 1889, pp. 49, 50, 66-81, 84-88.)
(See Proceedings 1897, pp 42-54, 61-77, 207-208.)
(See Proceedings 1898, pp. 49-100.)

(At the Tenth Annual Convention of the American Boiler Manufacturers' Association, held at St. Louis, Mo., Oct. 3-6, 1898, were *unanimously* adopted a complete set of boiler specifications, known as the Uniform Boiler Specifications. These contain, in addition to the requirements as to materials, methods and calculations, many reasons, arguments and explanations. The chairman of the committee was instructed to prepare an abridged form containing only the mandatory clauses. This, after submission to the other members of the committee and approval by them is here published.)

I. MATERIALS.

1. CAST IRON.—Should be of soft, gray texture and high degree of ductility. To be used only for hand-hole plates, crabs, yokes, etc., and man-heads. It is a dangerous metal to be used in mud drums, legs, necks, headers, manhole rings or any part of a boiler subject to tensile strains; its use is prohibited for such parts.

2. STEEL.—Homogeneous steel made by the open hearth or crucible processes, and having the following qualities, is to be used in all boilers:

Tensile Strength, Elongation, Chemical Tests.—Shell plates ***not*** exposed to the direct heat of the fire or gases of combustion; as in the external shells of internally fired boilers, may have from 65,000 to 70,000 pounds tensile strength: elongation not less than 24 per cent. in 8 inches: phosphorus not over .035 per cent.: sulphur not over .035 per cent.

Shell plates in any way exposed to the direct heat of the fire or the gases of combustion, as in the external shells or heads of externally fired boilers, or plates on which any flanging is to be done, to have from

60,000 to 65,000 pounds tensile strength; elongation not less than 27 per cent. in 8 inches; phosphorus not over .03 per cent.; sulphur not over .025 per cent.

Fire box plates or such as are exposed to the direct heat of the fire, or flanged on the greater portion of their periphery, to have 55,000 to 62,000 pounds tensile strength; elongation 30 per cent. in 8 inches; phosphorus not over .03 per cent.; sulphur not over .025 per cent.

For all plates the elastic limit to be at least one-half the ultimate strength; percentage of manganese and carbon left to the judgment of the steel maker.

Test Section to be 8 inches long, planed or milled edges; its cross sectional area not less than one-half of one square inch, nor width less than the thickness of the plate.

Bending Test.—Steel up to ½ inch thickness must stand bending double, and being hammered down on itself; above that thickness it must bend round a mandrel of diameter of one and one-half times the thickness of plate down to 180 degrees. All without showing signs of distress.

Bending Test Piece to be in length not less than sixteen times thickness of plate, and rough, shear edges milled or filed off. Such pieces to be cut both lengthwise and crosswise of the plate.

All tests to be made at the steel mill. Three pulling tests and three bending tests to be made from each heat. If one fails the manufacturer may furnish and test a fourth piece, but if two fail the entire heat to be rejected.

Certified copies of tests to be furnished each member of A. B. M. A. from heats from which his plates are made.

3. Rivets.—To be of good charcoal iron, or of a soft, mild steel, having the same physical and chemical properties as the fire box plates, and must test hot and cold by driving down on an anvil with the head in a die; by nicking and bending, by bending back on themselves cold, without developing cracks or flaws.

4. Boiler Tubes.—Of charcoal iron or mild steel specially made for the purpose, and lap welded or drawn; they should be round, straight, free from scales, blisters and mechanical defects, each tested to 500 pounds internal hydrostatic pressure.

This fact and manufacturer's name to be plainly stencilled on each tube.

Standard Thicknesses by Birmingham wire gauge to be

No. 13 for tubes 1 in., 1¼ in., 1½ in. and 1¾ in. diameter.
No. 12 for tubes 2 in., 2¼ in., and 2½ in. diameter.
No. 11 for tubes 2¾ in., 3 in., 3¼ in, and 3½ in. diameter.
No. 10 for tubes 3¾ in., and 4 in. diameter.
No. 9 for tubes 4½ in., and 5 in diameter.

Tests.—A section cut from one tube taken at random from a lot of 150 or less must stand hammering down cold vertically without cracking or splitting when down solid.

Length of test pieces:

¾ inch for tubes from 1 in. to 1¾ in. diameter.
1 inch for tubes from 2 in. to 2½ in. diameter.
1¼ inch for tubes from 2¾ in. to 3¾ in. diameter.
1½ inch for tubes from 3½ in. to 4 in. diameter.
1¾ inch for tubes from 4½ in. to 5 in. diameter.

All tubes must stand expanding flange over on tube plate and bending without flaw, crack or opening of the weld.

5. Stay Bolts.—To be made of iron or mild steel specially manufactured for the purpose, and must show on:

Test Section 8 inches long; net:

***For Iron*, tensile strength not less than 46,000 lbs.; elastic limit not less than 26,000 lbs.; elongation not less than 22 per cent. for bolts of less than one (1) square inch area, nor less than 20 per cent. for bolts one (1) square inch and more in net area.**

***For Steel*, tensile strength not less than 55,000 lbs.; elastic limit not less than 33,000 lbs.; elongation not less than 25 per cent. for bolts of less than one (1) square inch area, nor less than 22 per cent. for bolts one (1) square inch and more in net area.**

***Tests*. A bar taken from a lot of 1,000 lbs. or less at random, threaded with a sharp die "V" thread with rounded edges, must bend cold 180 deg. around a bar of same diameter without showing any crack or flaws.**

Another piece, similarly chosen, and threaded, to be screwed into well fitting nuts formed of pieces of the plates to be stayed, and riveted over so as to form an exact counterpart of the bolt in the finished structure; to be pulled in testing machine and breaking test noted: if it fails by pulling apart the tensile stress per square inch of net section is its measure of strength; if it fails by shearing the shear stress per square inch of mean section in shear is this measure. The mean

section in shear is the product of half the thickness of the plate by the circumference at half height of thread.

6. BRACES AND STAYS.— Material to be fully equal to stay bolt stock, and tensile strength to be determined by testing a bar not less than ten inches (10 in.) long from each lot of 1,000 lbs. or less.

II. WORKMANSHIP AND DIMENSIONS.

7. FLANGING, BENDING AND FORMING to be done at a heat suited to the material, but no bending must be done or blow struck on any plate which no longer shows red by daylight at the working point and at least 4 inches beyond it.

8. ROLLING must be done cold by gradual and regular increments from the straight plate to the exact circle required and the whole circumference including the lap rolled to a true circle.

9. BUMPED HEAD uniformly dished to a segment of a sphere should have a thickness equal to that of a cylindrical shell of solid plate of same material, whose diameter is equal to the radius of curvature of the dished head.

Rivet holes, man holes, etc., to be allowed for by proportionate increase in the thickness.

10. RIVETING. Holes made perfectly true and fair by clean cutting punches or drills. Sharp edges and burrs removed by slight counter sinking and burr reaming before and after sheets are joined together.

Under side of original rivet head must be flat, square and smooth. For rivets $\frac{5}{8}$ inch to $1\frac{3}{16}$ inch diameter allow $1\frac{1}{2}$ diameters for length of stock to form the head, and less for larger rivets. Allow 5 per cent. more stock for driven head for button set or snap rivets. Use light regulation riveting hammers until rivet is well upset in the hole; after that snap and heavy mauls. For machine riveting more stock to be left for driven head to make it equal to original head, as fixed by experiment.

Total pressure on the die about 80 tons for $1\frac{1}{8}$ inch to $1\frac{1}{4}$ inch rivets; 65 tons for 1 inch; 57 tons for $\frac{15}{16}$ inch; 35 tons $\frac{3}{4}$ inch rivets.

Make heads of rivets equal in strength to shanks by making head at periphery of shank of a height equal to $\frac{1}{3}$ diameter of shank and giving a slight fillet at this point.

Approximately make rivet holes double thickness of thinnest plate; pitch three times rivet hole; pitch lines of staggered rows $\frac{1}{2}$ pitch apart; lap for single riveting equal to pitch, for double riveting $1\frac{1}{3}$

pitch, and ⅝ pitch more for each additional row of rivets; *exact dimensions determined* by making resistance to shear of aggregate rivet section at least 10 per cent. greater than tensile strength of net or standing metal.

11. Rivet Holes punched with good sharp punches and well fitting dies in A. B. M. A. steel up to ⅝ inch thickness; in thicker plates punch and ream with a fluted reamer, or drill the holes.

12. Drift Pin to be used only with light hammers to pull plates into place and round up the hole, but never to enlarge or gouge holes with heavy hammers.

13. Calking to be done by hand or pneumatic hammer and Conery or round nosed tool. Avoid excessive calking; the fit must be made in the laying of the plates. The square nosed tool may be used for finishing with great care to avoid nicking lower plate. Calking edges must be prepared by bevel planing, shearing or chipping.

14. Flat Surfaces. State the thickness of the plate "t" in sixteenths of an inch, the pitch "p" in inches, and use a constant:

C=112 for plates $\frac{7}{16}$ inch and under with screw stays with riveted ends.

C=120 for plates over $\frac{7}{16}$ inch with screw stays with riveted ends.

C=140 for all plates when in addition to screw threads in the plates a nut is used inside and outside of each plate.

When salt, acids or alkali are contained in the feed water, this latter construction is imperative.

Rule.—Multiply this constant "C" by the square of the thickness of the plate expressed in sixteenths of an inch, and divide by the square of the pitch expressed in inches: the quotient is the safe working pressure "P".

$$\text{Formula:} \quad P = \frac{C \times t^2}{p^2}$$

15. Tube Holes either punched $\frac{1}{8}$ inch less than required diameter and reamed to full size, or drilled; then slightly countersunk on both sides; should be $\frac{1}{64}$ inch to $\frac{1}{16}$ inch larger than diameter of tube according to size of tube; if copper ferrules are used the hole to be a neat fit for the ferrule. Tube sheet to be annealed after punching and before reaming.

16. Tube Setting. Ends of tubes to be annealed (in the Tube Mill) before setting. The tube to extend through the sheet $\frac{1}{16}$ inch for every inch in diameter. Expand until tight in hole and no more. On end

exposed to direct flame, flange the tube partly over on sheet, finishing by beading tool which must not come in contact with the plate; expand slightly after beading.

Copper ferrules No. 18 to 14 wire gauge should be used in fire tube boilers on ends subject to direct heat.

17. RIVETED AND LAP WELDED FLUES, as prescribed in Rule 11, Sections 8, 9, 10, 11, 12 and 13 of Regulations of Board of Supervising Inspectors of Steam Vessels, approved February, 1895.

18. CORRUGATED FURNACE FLUES as prescribed in sections 14 and 15 of the same Rule.

19. STAY BOLTS to be carefully threaded with sharp clean dies "V" thread with rounded edges; threading machine equipped with a lead screw; holes tapped with tap extending through both sheets to neat smooth fit, so that bolts can be put in by hand lever or wrench with a steady pull; $\frac{1}{8}$ diameter to project for riveting over; with hollow stay-bolts use slender drift pin in the bore while riveting and drive it home to expand the bolt after riveting.

Height of nuts used on screw stays to be at least 50 per cent. of diameter of stay. Largest permissible pitch for screw stays is 10 inches.

20. BRACES AND STAYS shall be subjected to careful inspection and tests as per sections 6 and 2. Welding to be avoided where possible, but good clean welds to be allowed a value of 80 per cent. of the solid bar. Rivets by which braces are attached, when the pull on them is other than at right angles to be allowed only half the stress permitted for rivets in the seams.

21. MANHOLES should be flanged in, out of the solid plate, on a radius not less than three times the metal thickness to a straight flange; when the plate is $\frac{1}{2}$ inch or less in thickness a reinforce ring to be shrunk around it. Cast iron reinforce flanges never to be used.

22. DOMES to be avoided when possible; cylindrical portion to be flanged down to the shell of the boiler, and this shell flanged up inside the dome, or reinforced by a collar flanged at the joint, the flanges double riveted.

23. DRUMS should be put on with collar flanges of A. B. M. A. steel, not less than $\frac{3}{8}$ inch thick double riveted to shell and drum and single riveted to the neck or leg, or the flanges may be formed on these legs.

24. SADDLES OR NOZZLES to be of flanged steel plate or of soft cast steel, never of cast iron.

III. Factors of Safety.

25. Rivet Seams when proportioned as prescribed in Section 10 with materials tested as per Sections 2 and 3 shall have 4½ as factor of safety; when not so tested, but inspection of materials indicates good quality, a factor of safety of 5 is to be taken, and at most 55,000 lbs. tensile strength assumed for the steel plate and 40,000 lbs. shear strength for the rivets, all figured on the actual net standing metal.

26. Flat Surfaces proportioned as per Section 14 have in the constants there given a factor of safety of 5 or a little over.

27. Bumped Heads proportioned as per Section 9 to be subject to a factor of safety of 5.

28. Stay Bolts proportioned and tested as per Sections 19 and 5 to have a factor of safety of 5 applied to the lowest stress found.

29. Braces and Stays. When tested as per Sections 6 and 2 to be allowed a factor of safety of 5; when not so tested but careful inspection shows good stock they may be used up to 6,500 lbs actual direct pull for wrought iron, and 8,000 lbs. for mild steel, all per square inch of actual net metal.

IV. Hydrostatic Pressure.

30. The hydrostatic test, to be made on completed boilers built strictly to these specifications, is never to exceed working pressure by more than one-third of itself and this excess limited to 100 lbs. per square inch. The water used for testing to have a temperature of at least 125 deg. F.

V. Hanging or Supporting the Boiler.

31. The boiler should be supported on points where there is the greatest excess of strength. Excessive local stresses from weight of boiler and contents must be avoided and distortion of parts prevented by using long lugs or brackets, and only half the stress which they may carry in the seams, to be allowed on rivets.

The supports must permit rebuilding the furnace without disturbing the proper suspension of the boiler. The boiler should be slightly inclined so that a little less water shows at the gauge cocks than at the opposite end.

E. D. Meier, *Chairman.*

Henry J. Hartley,
John Mohr,
James G. Mitchell,
James C. Stewart,
James Lappan,
George N. Riley,
D. Connelly.

The PRESIDENT. Gentlemen, you have heard the paper and discussion of Col. MEIER and Mr. DEAN. It is to be regretted that Mr. DEAN is not here to enter into the discussion in person. There are some points which Col. MEIER speaks of in his paper which, if time permitted, I should like to take up with him. I would refer, Colonel, if you please, to the August number of the American Journal of Naval Engineers, containing notes of the trial of the Minerva and Hyacinth. Have you seen that?

Col. E. D. MEIER. No; the English vessels?

Mr. CHARLES H. FISH. Yes. And the author sums up this trial, which was a race between two torpedo boats, one with a Scotch boiler and the other with a watertube boiler, by saying: "The history of the trial is, as we have said, typical. We have the steady load Scotch boilers fairly used and doing their duty perfectly in the one vessel, and in the other we have the Belleville boiler doing as it would seem it always does when pressed. The ship could hardly reach Gibraltar at seven-tenths of her whole power, the old trouble, leakage, driving her into port, and it will be remembered that the Hyacinth is a comparatively new vessel, 1898," etc.

Col. E. D. MEIER. I would like to say in reference to that, Mr. President, that fully five or six years ago, before any such trial was thought of, I had a discussion with Admiral MELVILLE in regard to these very Belleville boilers, and he condemned them entirely. He is an advocate of water tube boilers, but not of the Belleville boilers. That is a peculiar type, and in that the natural circulation is not relied on, but the circulation is obtained by artificial means, and it is a boiler that is all composed of joints. It is more properly a pipe boiler than a water tube boiler.

Mr. CHARLES H. FISH. But is it not, Colonel, considered a water tube boiler?

Col. E. D. MEIER. As compared there, yes, but strictly speaking, I should call it more a pipe boiler. It is made up of a number of small sections screwed or rolled together, and there is no solidity to it. It is a boiler that is not susceptible to cleaning and it is very hard to get at for repairs. The boiler was at that time, five or six years ago, very forcibly pressed on the attention of the navy department, and met with utter condemnation from Admiral MELVILLE, and that he was right, this trial shows. But he has adopted water tube boilers in the navy and is very much in favor of them.

Mr. CHARLES H. FISH. This author, after speaking of the boiler tube bursting on board the Hyacinth when the fireman was so severely scalded that he had to be sent to the hospital, ends by saying: "We venture to think that in the light of the results of this trial, the Admiralty may feel thoroughly justified in proceeding to fit the ships of the navy with properly designed cylindrical boilers until such time, say five years hence, as they have reason to believe that a really satisfactory water tube boiler is available." So this author evidently thinks that it may be possible to make a water tube boiler which will be satisfactory.

Col. E. D. MEIER. I will say right here while it may seem very strange, in view of the remarks made by Mr. DEAN, that I should say something for a rival, that the Marietta, which accompanied the Oregon on her trip from California to Key West, was fitted with Babcock & Wilcox water tube boilers, an American water tube boiler. I do not think that is the best that can be built, but it is infinitely superior to the Belleville boiler that is mentioned there.

Mr. CHARLES H. FISH. I note in your paper, Colonel, on page 322, you say: "Large shells present greater structural difficulties and collapsing stresses must be avoided." Have you in mind any incident where boiler tubes have collapsed from internal pressure?

Col. E. D. MEIER. O, yes. That is quite a frequent occurrence where they carry high pressures on the Mississippi River. There have been many disastrous results from collapse in that way. And then you can find — I am speaking entirely from memory now, but you can find in the tests made by the various tube mills that the tubes will stand external pressure only from two-thirds to one-half as much as they will internal pressure. And that is of course for a very perfect tube. The moment the tube becomes the least bit deformed or becomes thinner in one part than the other, it will not stand anything near as much, whereas an internal pressure on a tube tends to make it round, and it gets into a stronger form the higher the pressure. In regard to the structural difficulties of making very large shells, speaking of these Scotch marine boilers, I have seen these large Scotch marine boilers built at the Cramp ship building works, where they do exceptionally fine work, and you can see how difficult it would be to get plates which are 1¼ to 1½ inches in thickness to lay up as snug as you can a one-half inch plate. I have seen plates stand off after riveting, even under the most powerful riveting machines, — they have, of course, very powerful hydraulic riveting machines there, — I have seen the plates stand out so that you can easily run the blade of your knife in between. That has all to be taken care of by calking.

INDEX.

A

Active Members 13
Alphabetical List of Members . 13
Allen, Frederick K., Elected an Active Member 96
Arkwright's Patent for Rolls . . 260
Associate Members 28
Attendance at Pan-American Meeting 56

B

Baling Cotton, Wm. S. Southworth 219
Barton, Philip P., Plant of the Niagara Falls Power Company 182
Bates Mill at Greenville, S. C. . 298
Bennett, Frank P., Jr., Evolution of the Slubbing Frame . . . 258
Bleaching, Chemistry of, Tailfer . 205
Board of Government 9
Boiler Problems, Modern, Col. E. D. Meier 312
Boiler Specifications, Adopted by the American Boiler Manufacturers' Association 334
Bosca and Benner Unrolling Attachment to Pickers for Round Lap Bales 222
Boundary Line Between North and South Carolina 300
Buffalo Merchants' Exchange, Reception by 90
Butler, Mighells B , Address of Welcome 77
By-laws 5

C

Call to Pan-American Meeting . 66
Card Room, Overworking of Cotton in, Edward W. Thomas . 233
Carding, Overworking of Cotton, Edward W. Thomas 233
Carter, Samuel A., Elected an Active Member 96
Case, Albert C., Elected an Associate Member 96
Charleston, S. C., Exposition . . 301
Charter 3
Cloth, Loading of 305
Coals, Combustion of Different . 319
Combustion of Different Coals . 319
Commercial Museum in Japan . 177
Committee on Resolutions to President McKinley 85
Committee on Tablet to Eli Whitney 89
Connecting Rods 284
Constitution and By-laws . . . 5
Coolidge, Sidney, Elected an Active Member 96
Cotton Crop, 1901, Value of . . 237
Cotton Fibre in Some of Its Phases, Henry G. Kittredge . 204
Cotton, Specific Gravity of . . . 210
Cotton Waste, Col. Samuel Webber 239

Creed, P. T., Thread Boards and Guides 249
Cuban Cotton Trade 304
Cuticle of Cotton Fibre 204

D

Davenport, E. W., Elected an Associate Member 96
Deabill, Albert, Knitting Industry in the United States . . . 251
Dean, F. W., Discussion on Col. Meier's paper 623
Denny, Chas. A., on Tablet to Eli Whitney 73
Dickinson, John W., Jr., died June 4, 1900 53
Dickinson, John W., Jr., Sketch of 53
Distribution of Membership . . 51
Draper, George Otis, Resolution on Tablet to Eli Whitney . 73—86

E

Earle, Benjamin M., Elected an Active Member 96
Early Southern Cotton Mills, D. A. Tompkins 295
Election of Members 95
Electric Transmission of Power at Niagara Falls, Philip P. Barton 182
Eli Whitney, Tablet to . . 73—86
Evolution of the Slubbing Frame Frank P. Bennett, Jr. 258

F

Fibre of Cotton, Henry G. Kittredge 204
Fibres of Cotton, Unripe 241
Firth, William, Presents Textile School Scholarship to the Association 94
Firth, William, Vote of Thanks to 95
Fish, Charles H., Belleville and Scotch Boilers 341
Fish, Charles H., Member of Committee on Tablet to Eli Whitney 89
Fish, Charles H., President's Address 79
Fish, Charles H., Round Lap Bales 229
Foster, M. F., Chairman of Committee on Tablet to Eli Whitney 89
Foster, M. F., Member of Committee on Resolutions to President McKinley 85
Fritz, John, Tribute to 294
Fukuhara, Hachiro H., The Past, Present and Future of the Cotton Industry in Japan 124
Furnace Capacity for Boilers . . 313

G

Geographical List of Members . 35
Gilligan, Daniel J., died June 25, 1901 54
Gilligan, Daniel J., Sketch of . . 54
Government, Board of 9
Greene, Stephen, died Nov. 7, 1901 55
Greene, Stephen, Sketch of . . 55
Greenville, S. C., Bates Mill at . 298
Gulliver, A. H., Chairman of Committee on Resolutions to President McKinley 85

H

Haight, Effingham C., died July 18, 1901 54
Haight, Effingham C., Sketch of 54
Halliwell, Wm., Elected an Active Member 96

Harris, A. G., Elected an Active Member 96
Hartford Steam Boiler Inspection and Insurance Company, Cited for Record of Boiler Explosions 331
Heaviness of Cotton 210
Holmes, Early Cotton Gin Patent 87
Honorary Members 13
Hosiery . Manufacture, Albert Deabill 251
Houghton, Lewis T., Elected an Associate Member 96
Houghton, Lewis T., Thread Boards and Guides 245
Howard, A. H., Elected an Associate Member 97

I

Interest, Rate of, in Japan . . . 169
Itinerary to Pan-American Meeting . . . . . 62—67

J

Japan, Past, Present and Future of Cotton Industry in, Hachiro H. Fukuhara 124

K

Keeler, Lawrence M., Elected an Associate Member 97
Kittredge, Henry G., Cotton Fibre in Some of Its Phases . 204
Knitting Industry in the United States, Albert Deabill 251

L

Laps, Differences in 234
Letchworth, Ogden P., President Buffalo Merchants' Exchange . 90
Lincolnton, N. C., Michael Schenck Mill at 297
Loading of Cotton Fabrics . . . 305

M

Maddocks, John, Mercerization of Cotton 212
Maddocks, John, Tribute to President McKinley 216
Martin, Fay H., Elected an Associate Member 97
Manufacturing Industries: Their Relations to National Position and Progress, Dr. Robert H. Thurston, ... 102
Maxwell, Scott, Elected an Active Member 96
Mayor of Niagara Falls, Address of Welcome 77
McKinley, President, Resolutions to 85
McKinley, President, Tribute by John Maddocks 216
McMeehan, Robert G., Elected an Active Member 96
Meier, Col. E. D., Modern Boiler Problems 312
Members, Election of 95
Membership, List of 13
Memorial Sketches 53
Mercerization, Henry G. Kittredge 208
Mercerization of Cotton, John Maddocks 212
Milburn, Hon. John G., Address to Association, ... 91
Modern Boiler Problems, Col. E. D. Meier 312
Moisture in Cotton 220
Montgomery, J. R., Member of Committee on Resolutions to President McKinley 85
Montgomery, J. R., Mercerization of Cotton 211
Montgomery, J. R., Round Lap Bales 227
Morton, E. P., Elected an Active Member 96

N

New York State Building, Reception at 90
Niagara Falls Excursion . . . 68-70
Niagara Falls Power Company, Philip P. Barton 182
Noone, Albert W., Elected an Active Member 96
Northrop Loom, Advantage of . 308
Notice to Pan-American Meeting, Preliminary 62
Number of Members 34

O

Oil Tempering of Shafting . . . 282
Over-working of Cotton in the Card Room, Edward W. Thomas 233

P

Pan-American Meeting, Call to . 66
Picker, Roundlap Bale Feeding Attachment, Bosca & Benner 222
Photograph of Members at Niagara Falls 89
Porter, H. F. J., Steel Forgings for Factory Engines 267
Possibilities of Trade Expansion in Cotton Manufactures, William Whittam, Jr. 303
Power, Electric Transmission of at Niagara Falls 182
Power Utilized at Niagara Falls, 78
Preliminary Notice to Pan-American Meeting 62
President McKinley, Tribute to D. A. Tompkins 295
President's Address, Charles H. Fish 79
Prest, John E., Round Lap Bales 224
Prest, John E., Thread Boards and Guides 249
Pritchett, Henry Smith, Elected an Honorary Member 95
Proceedings 56
Programme Pan-American Meeting 69

R

Reception to Association at Pan-American Exposition 90
Reprint of Vol. 56, Transactions 62
Resolutions to President McKinley 85
Rocky Creek Farm 72
Round Bale at the Mill, Wm. S. Southworth 219

S

Schenck, Michael, Cotton Mill, Lincolnton, N. C. 297
Shafting, Hollow Steel 279
Shafting, Steel, H. F. J. Porter, 267
Silk, Artificial 206
Slubbing Frame, Evolution of, Frank P. Bennett 258
Smith, Joel, Round Lap Bales . 225
Smith, Joel, Thread Boards and Guides 249
Smith, J. C., Round Lap Bales . 231
South American Trade 301
Southern Cotton Mills, Early, D. A. Tompkins 295
Southworth, Wm. S., The Round Bale at the Mill 219
Specific Gravity of Cotton . . . 210
Specifications for Steel Forgings 290
Steel Forgings for Factory Engines, H. F. J. Porter 267
Stowe, B. L., Elected an Active Member 96

T

Tablet to Eli Whitney 73-86

Tailfer on Chemistry of Bleaching 205
Tare on Round Lap Bales . 219-223
Testing of Steel Forgings . . . 292
Textile School Scholarship Presented by William Firth . . . 94
Thayer, S. Willard, Elected an Active Member 96
Thomas, Edward W., Overworking of Cotton in the Card Room 233
Thread Boards and Guides, Lewis T. Houghton 245
Thurston, Dr. Robert H., Manufacturing Industries: their Relations to National Position and Progress 102
Tompkins, D. A., Early Southern Cotton Mills 295
Tompkins, D. A., Member of Committee on Tablet to Eli Whitney 89
Tompkins, D. A., Whitney's Invention of Cotton Gin 87
Trade Expansion in Cotton Manufactures, Possibilities of, William Whittam, Jr. 303
Transactions, Reprint of Vol. 56, 62
Truesdell, Oscar B., Tare on Round Lap Bales 223
Tryon, George F., Died Sept. 4, 1900 53
Tryon, George F,, Sketch of . . 53

U

Uniform Boiler Specifications adopted by American Boiler Manufacturers' Association . . 334
Unripe Fibres of Cotton 241

V

Visitor's Information Bureau . . 64

W

Wages in Japan 178
Waste, Col. Samuel Webber . . 239
Waste in Hosiery Yarn, Albert Deabill 225
Water Wheels, Early Types . . 268
Webber, Col. Samuel, Cotton Waste 239
Welcome, Address of M. B. Butler 77
Whaley, W. B. Smith, Member of Committee on Tablet to Eli Whitney 89
Whitney, Eli, Committee on Tablet to 89
Whitney, Eli, Tablet to Memory of 73–86
Whittam, William, Jr., Possibilities of Trade Expansion in Cotton Manufactures 303
Woodbury, C. J. H., Member of Committee on Tablet to Eli Whitney 89

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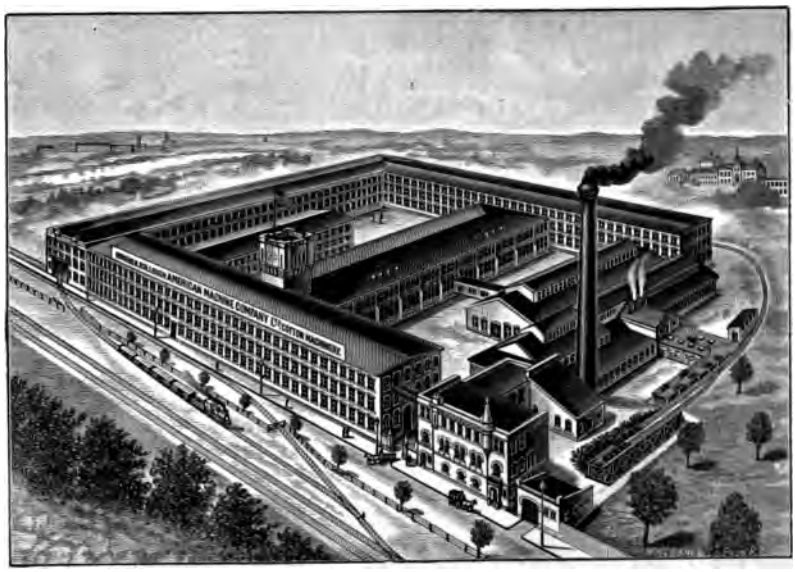

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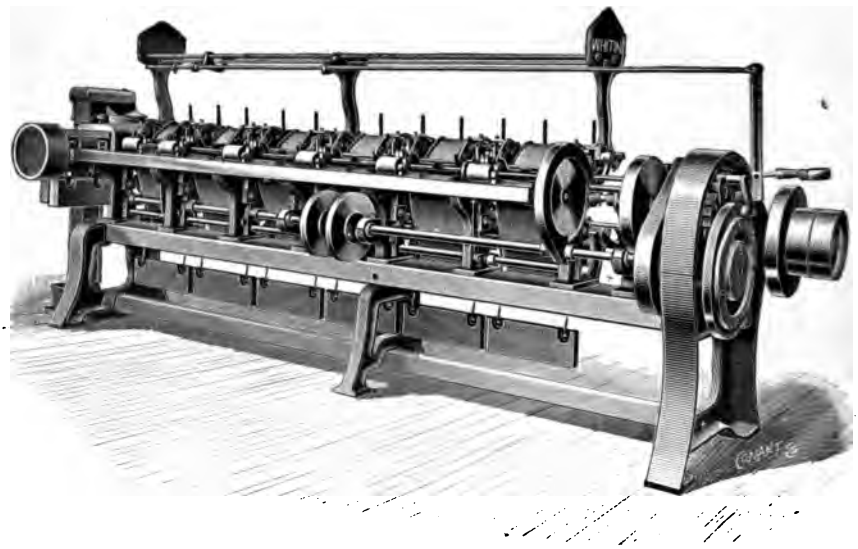

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Flax Straw and Tow.

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Yarns, Slubbing, etc., etc.
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all of the above in whatever form required.

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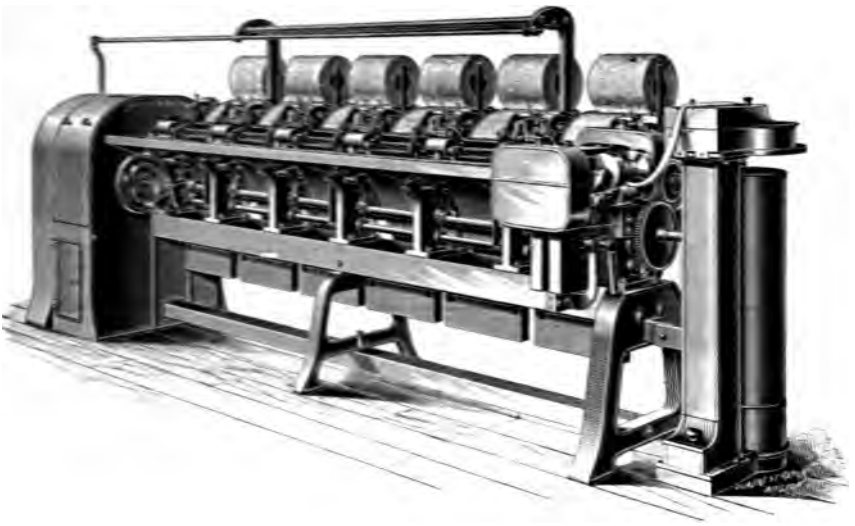
COTTON MILL MACHINERY.



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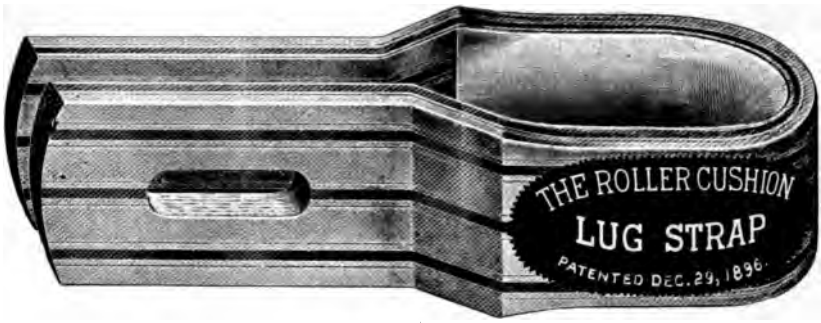

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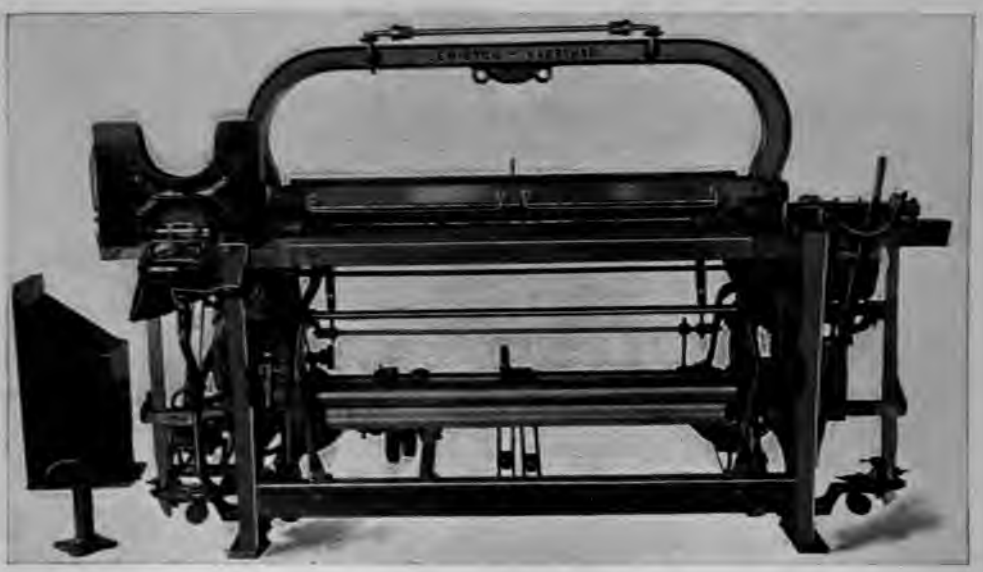

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Automatic Shuttle Changing Loom.

Continuous Running Pattern. Speed of Loom not governed by mechanisms.

CAN RUN ANY SHUTTLE.

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OF ALL KINDS

FOR MILLS AND FACTORIES.

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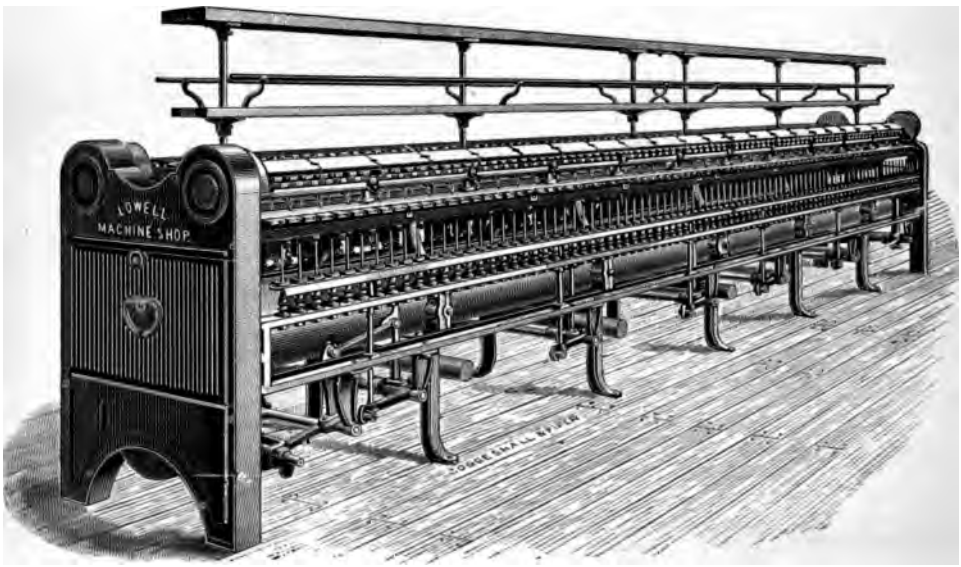

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Drawing Frames,
Roving Frames,
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Twisters, Spoolers,
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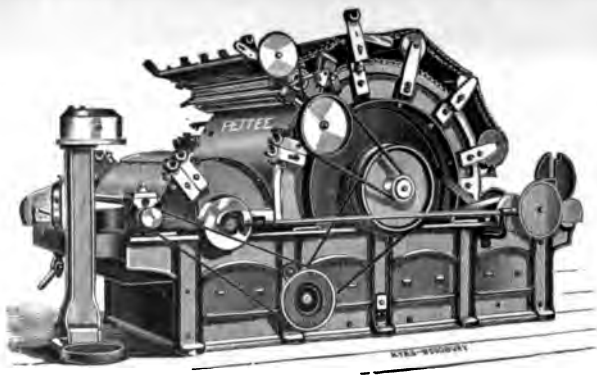

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Send for estimates and prices.

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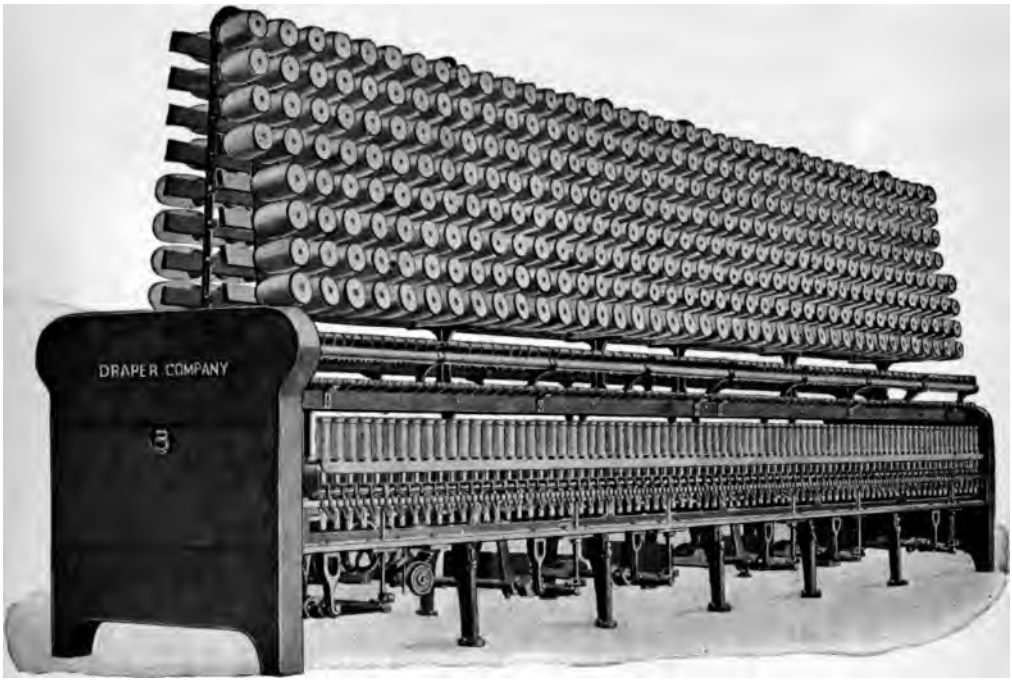

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Made Throughout from New Patterns.

Extra Weight,
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Adjustable Legs,
New Patented Details.

BUILT FOR SPEED.

The demand for our Twisters steadily increases. We also build Northrop Looms, Warpers, Spoolers, Reels, Banding Machines, Spindles, Temples, Round Spinning Rings, Separators, etc.

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Bright Hardened and Tempered Steel Wire, Plough Ground or Surface Ground.

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All makes of Top Flats Reclothed by Ashworth's Patent Steel Clamp Fastening.

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Try our New Mail Heddles for Jacquard Looms.

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By the use of Platt's Cotton Machinery for either fine or coarse work, a larger production of better quality can be obtained at less cost.

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New Patent Noble Comb — Increased production, better work.

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Superior Harness Frames—Iron End Frames a Specialty.

Special attention is called to our Heddles and Harness Frames as being perfectly adapted to weaving the finest fancy cotton goods. We are also *AGENTS and IMPORTERS of the German Tinned Cast Steel Wire Heddles.*

These Heddles are made with soldered warp eyes, also soldered end eyes, and are the most DESIRABLE FOREIGN HEDDLE MADE.

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designs and installs

Electric Power and Lighting Plants

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Stripping Cards and Wire Heddles.

OUTSIDE OF THE CARD CLOTHING COMBINE.

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STEAM
HYDRAULIC
ELECTRICAL
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INDUSTRIAL TRUST BUILDING,
PROVIDENCE, R. I.

71—72 T. F.

The Roundlap Bale at the Mill.

In connection with the tests reported by Mr. Wm. S. Southworth and Mr. Oscar B. Truesdell at the Pan-American meeting of the New England Cotton Manufacturers' Association (see pages 219, 220, 223 of this number of the Transactions) the testimony of European spinners as to the advantages of The American Cotton Company's Roundlap bale is highly interesting.

The organ of the Austrian Spinners' Association in September, 1901, published an analysis of letters received from the owners of more than 2,000,000 spindles relative to the merits of this package.

"Some important mills," the Austrian Spinners' organ says, "which have consumed large quantities of Roundlap bales, affirm that these bales give a better outturn than the ordinary bales, taking the same class and the same cleanliness. * * * Several spinners have, in fact, asserted that Roundlap bales are, almost without exception, free from sand."

"With reference to tare," to quote again, "it is generally admitted that the 1 per cent. allowed by The American Cotton Company is sufficient. One mill observes that the tare this season has been greater than ever before, never, however, reaching 1 per cent."

The Austrian Spinners' organ further says: "Our belief is that the Roundlap bale (or any other package possessing the same characteristics) will eventually bring about a thorough reform in the freight and insurance tariffs, thereby diminishing the cost of production for the European mills. This will enable the latter to compete on a more advantageous footing with the American mills."

The European market will readily absorb every Roundlap bale made.

American spinners who compete with European mills should not overlook the important advantage which the use of Roundlap bales confers.

New England mills supplied by the Howel Cotton Co., 831 Exchange Building, Boston.

THE AMERICAN COTTON COMPANY.

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PATENT, WARPING, BALLING, AND BEAMING MACHINES.

Also, all kinds of Expansion Combs for Warpers, Beamers and Slashers. ALSO TRAVERSE WHEEL AND ROLL GRINDERS FOR AMERICAN OR ENGLISH COTTON, WOOLEN OR WORSTED CARDS.

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Patented July 9th, 1901, and Patents Pending.

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The Green Fuel Economizer Company

OF MATTEAWAN, N. Y.

H. G. BRINCKERHOFF, New England Manager.

GREEN'S ECONOMIZER, Already applied to Three Hundred Thousand Steam Boilers.

53 STATE ST., BOSTON. Telephone, Main 1653.

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Investments, Seven per Cent. and Upwards.

In our engineering contract work of constructing cotton mills and cotton seed oil mills in the Southern States, we have come into the possession of some preferred stock in New Southern Cotton Mills. This stock bears a cumulative dividend of seven per cent. and becomes a lien on the property in case of liquidation, thus being the equivalent of mortgage and quite as safe. We offer part of what we have at par, plus accrued interest.

We have also considerable stock in Southern Cotton Mills that have been in profitable operation for some years.

All stocks we offer are in mills that are well designed, well built, well managed and *dividend paying.*

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Engineers and Contractors. **CHARLOTTE, N. C.**

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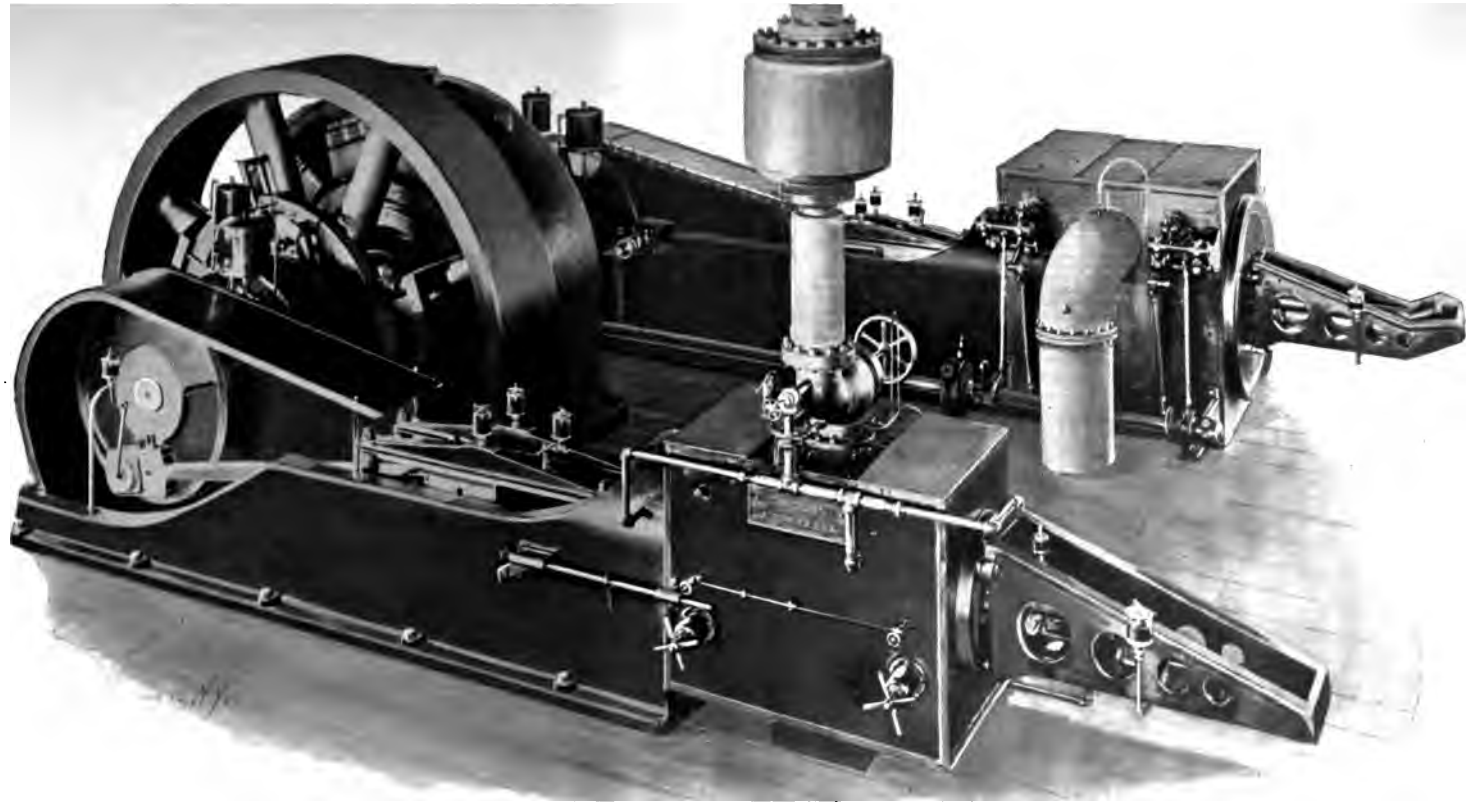

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MINERAL TANNED LEATHER.

SPECIALTY:

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It tells WHERE THE MARKETS ARE and by whom supplied. Who the RESPONSIBLE BUYERS ARE and HOW TO REACH THEM.

It can ascertain FOR YOU the particular REQUIREMENTS of any or all markets in THE LINE OF GOODS YOU MAKE.

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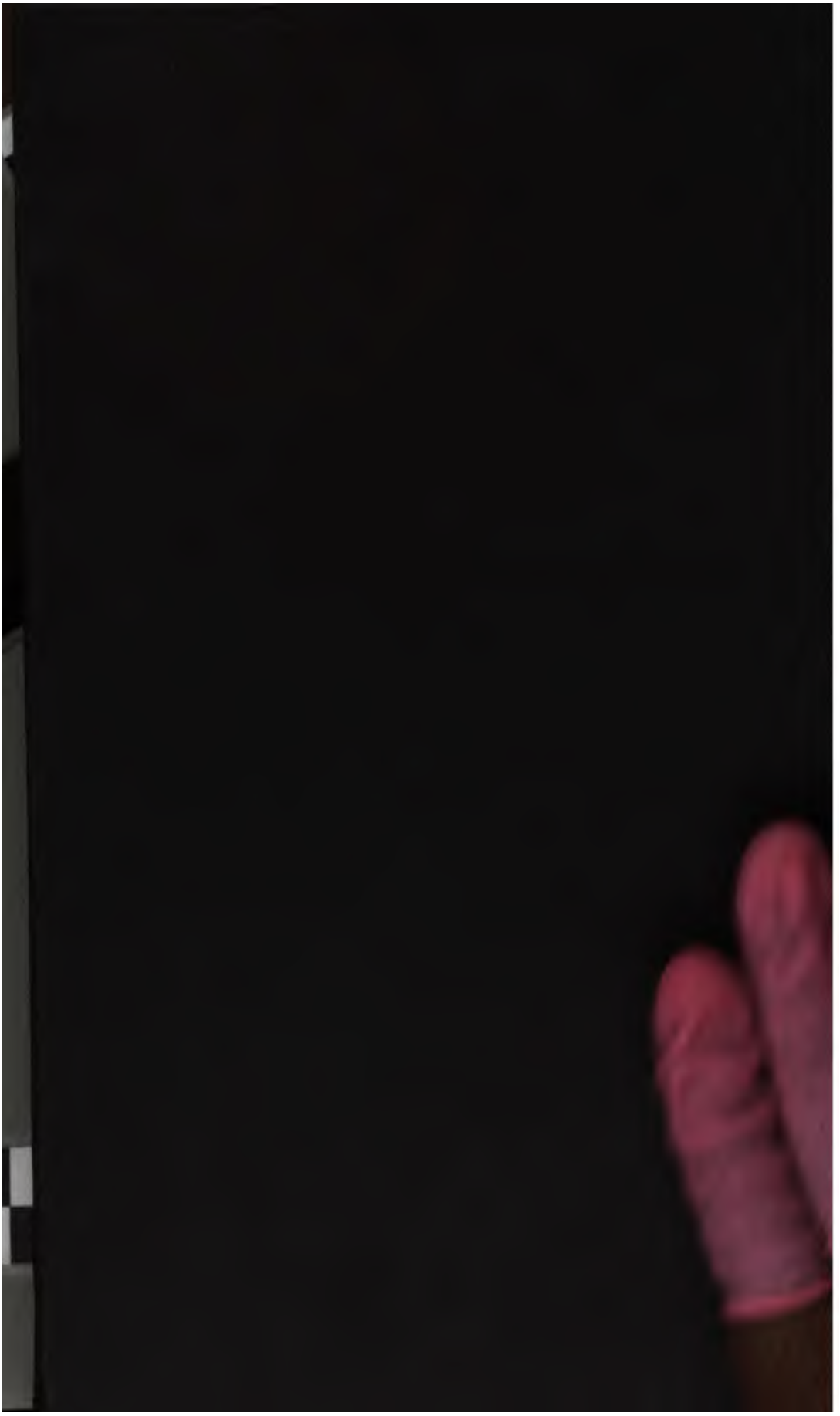
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